FOR CONTRACT NO.: 01-478304

INFORMATIONAL HANDOUT

WATER QUALITY

YUROK TRIBE WATER QUALITY CONTROL

YTWQP 09-008

MATERIALS INFORMATION

FOUNDATION REPORT DATED 09-11-08

FOUNDATION REPORT ADDENDUM DATED 01-30-09

FOUNDATION REVIEW DATED 04-02-09

MINES AND TUNNELS CLASSIFICATION

ROUTE: 01-HUM-169-18.1, 19.5

YUROK TRIBE

190 Klamath Boulevard • Post Office Box 1027 • Klamath, CA 95548
Phone: (707) 482-1350 • Fax: (707) 482-1377

YTWQP-09-008

Gary Berrigan
Chief
North Region Environmental Planning Branch E1
CA Department of Transportation
PO BOX 3700
Eureka, CA 95502-3700

Subject: Yurok Tribe Water Quality Control Plan Section 401 Water Quality Certification for *Highway 169-Retaining Wall and Slip-out Repair Project PM 18.04 and 19.47 EA 47830*

Dear Mr. Berrigan:

The Yurok Tribe Environmental Program (YTEP) received the complete application for Yurok Tribe Water Quality Certification of the *Highway 169-Retaining Wall and Slip-out Repair Project PM 18.04 and 19.47 EA 47830* under the Yurok Tribe Water Quality Control Plan Section 4.4 provisions on July 6, 2009. Thank you for providing a thorough and complete application. YTEP staff has reviewed the application and completed a site review with your staff.

Project Description

According to the project description and supporting documentation, the purpose of the project is for the California Department of Transportation to repair one minor slip-out and replace one failed retaining wall on State Route 169 at post miles 18.04 and 19.47, respectively.

Certification

We hereby grant Yurok Tribe Water Quality Control Plan Section 401 Certification for your project with the following conditions:

1. All work in and directly adjacent to waters of the United States directly associated with this project shall occur between May 15th and October 15th for calendar years 2010 and 2011. This permit is valid for this period only. Should the project need to be extended, early consultation with YTEP should be initiated.

2. All sites will be 'winterized' prior to seasonal work shut down. **An inspection by Yurok Tribe staff shall be requested at least 7 days in advance of seasonal work shut down.** The applicant may request seasonal extensions based on field review by YTEP.

3. You shall limit any excavation work in and adjacent to applicable waters to that necessary for the project.

4. No construction materials -- including cement, debris, oil or petroleum products, sand, sawdust, silt, slash, or soil -- shall be allowed to enter or be placed where it may enter the live channel of applicable waters in amounts that are considered to have adverse effects on the beneficial uses.

5. You shall not permanently dispose of any construction material, demolition wastes, wastewater, or any other pollutant within applicable waters or on any lands within the Yurok Reservation boundaries.

6. Water used in dust suppression shall contain no contaminants that could violate surface water or aquifer standards (see Yurok Tribe Water Quality Control Plan for water quality objectives).

7. All stationary machinery that uses gasoline or diesel fuel shall be placed within impermeable spill containment vessels capable of preventing migration of fuel in the event of a spill.

8. All contractors and subcontractors shall report, verbally and in writing, immediately upon discovery, any spills of chemical contaminants, including oil, gasoline, hydraulic fluid, or diesel fuel, during or after operations. Reports shall be submitted to EPA Region 9 and the Yurok Tribe. Appropriate cleanup of spills shall commence immediately. Within two weeks following cleanup, a summary report shall be submitted to EPA Region 9 and the Yurok Tribe that describes the reason for the spill, the spill duration and volume, steps taken to correct the problem, the remediation/clean up activities and steps taken to prevent a recurrence of the problem.

9. Best Management Practices (BMPs) for erosion and sedimentation control shall be implemented in accordance with the project description provided in the permit application and in place prior to, during, and after construction in order to ensure that negligible discharges to applicable waters do not occur.

10. You shall revegetate the slope face that will be impacted for staging, equipment access, and construction with comparable vegetation types. Areas that are denuded of trees taller than 3 feet in height and greater than 2 inches in diameter will be replaced with saplings of the same species. Any Douglas-fir that is removed shall be replaced with an appropriate hardwood species. Pre and post documentation of the revegetation work is required.

11. Water discharged from the project site shall not contain settleable materials or suspended materials in concentrations that cause nuisance or adversely affect beneficial uses. The

project shall not violate any narrative and numeric criteria established in the Yurok Tribe Water Quality Control Plan (see Yurok Tribe Water Quality Control Plan for water quality objectives)

12. If, at any time, an unauthorized discharge to surface water occurs, or any water quality problem arises, the project shall cease immediately and you shall immediately notify EPA Region 9 and the Yurok Tribe.

13. Yurok Tribe shall be notified at least three business days in advance of construction in order to allow staff to be present during construction.

14. If there are any substantive changes in the proposed project that may affect water quality, you shall notify the Yurok Tribe Environmental Program, immediately. Failure to do so will result in revocation of this certification.

15. You shall provide a copy of this certification to all contractors and subcontractors. You also shall review the conditions of this certification with all such contractors and subcontractors.

16. You shall request written permission for any activities related to water withdrawal and or water drafting prior to commencement of this activity. Written requests for water withdrawal shall be submitted to YTEP.

The point of contact at the Yurok Tribe is Ken Fetcho. Please contact Mr. Fetcho at (707) 954-1523 or at kfetcho@yuroktribe.nsn.us the point of contact for the proposed project at EPA Region 9 is Jason Brush. Please contact Mr. Brush at (415) 972-3483 or at brush.jason@epa.gov.

Sincerely,

Kathleen Sloan

Kathleen Sloan
Director
Yurok Tribe Environmental Program

e-copy:

Carol Heidsiek, U.S. Army Corps of Engineers, Eureka
Jason Brush, U.S. Environmental Protection Agency
David Hillemeier, Yurok Tribe Fisheries, Klamath
Maria Tripp, Chair, Yurok Tribe
Ralph Simon, Executive Director, Yurok Tribe
Robert McConnell, Yurok Tribe Historic Preservation Officer

Rain Marshall, Staff Attorney, Yurok Tribe
Javier Kinney, Transportation Manager, Yurok Tribe
Ken Fetcho, Assistant Director, Yurok Tribe Environmental Program

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TECHNICAL MEMORANDUM

Geotechnical Engineering
Materials Testing & Inspection
Environmental Science & Engineering
Water Resources
Earthquake Engineering
Air Quality

Date: September 11, 2008

To: Charlie Narwold, Sr. Engineering Geologist
Division of Engineering Services
Office of Geotechnical Design North
Branch B

From: Terry Craven, G.E.
William V. McCormick, C.E.G.

Kleinfelder Project: 92859/REP-3

Subject: Foundation Report (Wall/Roadway Failure)
Storm Damage Repair
HUM 169 PM 19.47
EA: 01-478301
Humboldt County, CA

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1 PROJECT DESCRIPTION

A landslide is located on the west (downhill) side of Highway 169, near milepost 19.47, northwest of Weitchpec in Humboldt County, California. The location of the site is shown on Plate 1, Site Location. As shown on Site Plan, Plate 2, the main landslide scarp is approximately 300 feet long. The landslide mass extends down slope to the west; however, a distinct toe was not observed (see Plates 3, 4, and 5). Tension cracks at the top of the landslide scarp extend up to 10 feet east (upslope) of the edge of pavement into the roadway. A soldier pile and timber lagging wall with no tie-backs is located 12 feet west of the edge of pavement in the central portion of the site. An approximately 15-foot-wide section of the base of the timber lagging wall has failed allowing the backfill to erode to a vertical scar which extends to within 5 feet of the western edge of the roadway. Soil creep and several shallow debris slides are located to the east above the roadway, both within and beyond the cut slope.

The purpose of this project is to provide geotechnical design parameters for a retaining structure to protect the road prism from active landslide related movement below the road. Stabilization of the portion of the landslide that is west of the proposed retaining wall is not

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intended and the main mass of the landslide may continue to move downslope of the proposed wall after the retaining structure is constructed. Further, the existing slopes are very steep for a considerable distance above the road and there is evidence of landslide activity in this area. An evaluation of the slopes above (east of) the road is beyond the scope of this study.

2 GEOTECHNICAL SCOPE OF WORK

The scope of our work for this project included the following:

- Review of available geologic information addressing this area.
- Geologic mapping of the landslide and immediate vicinity.
- Drilling, logging, and sampling of five exploratory borings.
- Installation of one inclinometer.
- Laboratory testing of selected samples from the borings.
- Global stability analyses.
- Preparation of Log of Test Borings (LOTBs).
- Preparation of this summary report.

3 PERTINENT REPORTS AND INVESTIGATIONS

In preparation of this memorandum, the following documents/reports were reviewed:

1987, Wagner & Saucedo, California Division of Mines and Geology, Geologic Map of the Weed Quadrangle

Caltrans Seismic Hazard Map and Report, Mualchin, 1996 with errata dated March 2006.

4 PROPOSED STRUCTURE DESCRIPTION

It is proposed to construct a retaining structure on the west side of the existing roadway to protect the road surface and supporting prism from landslide-related damage. As proposed, the retaining structure will be a soldier pile and lagging wall, portions of which will probably be restrained by tiebacks. The wall will be located west of the road shoulder. At the direction of Caltrans, the wall will be located approximately four feet outside of the edge of pavement. Our recommendations for the lateral limits of the wall are illustrated on Plate 2.

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5 SITE DESCRIPTION AND TOPOGRAPHY

At Post Mile 19.47, the single lane Highway 169 roadway rises very gently to the north at approximately 70H:1V to 23H:1V (Horizontal:Vertical). Slope gradients west (downslope) of the roadway range from approximately 1.1H:1V to 1.5H:1V. An approximately 75-foot-long by 14-foot-tall solider pile and timber lagging retaining wall with no tie-backs is located approximately 12 feet west of the edge of pavement in the central portion of the site. The cut slopes bordering the east of the roadway were constructed at approximately 0.4H:1V to 0.7H:1V. Gradients of the natural slope above the cut slope range from approximately 0.7H:1V to 1.2H:1V.

The landslide movement currently impacting the roadway is largely translational with an estimated average mass thickness of approximately 5 to 15 feet, but estimated to be up to 25 feet thick at the edge of the roadway fill prism. The arcuate head scarp of the landslide extends into the roadway up to 10 feet to the east (upslope) from the western edge of the pavement and has a lateral extent of approximately 300 feet along the roadway. An approximately 15-foot-wide section of the base of the approximately 80-foot-long soldier pile and timber lagging wall failed, allowing the backfill to erode away and beneath the wall forming a vertical scar which extends to within 5 feet of the western edge of the roadway. Erosion rilling has developed beneath the failed section of the wall. Soil creep and several shallow debris slides are located to the east above the roadway, both within and beyond the cut slope.

A shallow V-ditch along the eastern edge of the roadway collects sheet flow from the cut slopes and transports it to the south. Drainage from the center of the lane within the landslide flows down over the slope face of the fill prism. Mixed conifer and oak forest is located within the active slide and above the roadway. The cut slopes are vegetated with low to moderate growth of wild grasses.

6 SUBSURFACE EXPLORATION AND LAB TESTING

SUBSURFACE INVESTIGATION

Five (5) exploration borings, designated R-08-001 through R-08-005, were drilled at this site by Caltrans Office of Drilling Services using rotary wash drilling methods. Drilling was performed on March 31, 2008, through April 10, 2008. All drilling and sampling operations were supervised by Kleinfelder staff. Test borings were performed using truck-mounted Acker MPCA drill rig utilizing 94-mm (HXB) casing equipped with a tungsten carbide Geo Barrel or #8 diamond impregnated core bit. Borings R-08-001, R-08-002, R-08-004, and R-08-005 were advanced from Highway 169 pavement level along the western edge of the road to depths ranging from 50 to 75 feet. Boring R-08-003 was advanced to a depth of 50 feet on the eastern edge of the road. The approximate locations of the borings are shown on Plate 2.

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Samples of the soil and bedrock were obtained by coring, using equipment as described above, and using 2-inch (inside diameter) Modified California and 1.4-inch (inside diameter) Standard Penetration Test samplers, each driven with an automatic 140-pound hammer dropped 30 inches. The blows required to drive the Modified California and Standard Penetration Test samplers were recorded for each 6 inches of penetration or fraction thereof. Visual classifications were made in accordance with the attached Soil and Rock Legend. The results of the exploration are summarized on the attached Log of Test Borings.

As part of this work, one slope inclinometer casing was installed to approximately 75 feet below the ground surface within the bore hole for Boring R-08-004. The casing was perforated for its full length except for the upper 15 feet to permit possible monitoring of future water levels within the casing. The annular space around the casing was backfilled with sand to a depth of 6 feet and the remaining upper portion was backfilled with bentonite. The inclinometer was completed at the surface with a traffic-rated access box. No inclinometer readings or water level measurements were obtained at the time of installation. Inclinometer readings were obtained by Caltrans on April 16, April 23, June 5, June 24, and July 8 of 2008. Results are presented in Appendix C.

LABORATORY TESTING

Laboratory testing of selected soil samples obtained from the test borings was performed at Kleinfelder's Geotechnical Laboratory in Santa Rosa, California. The purpose of the testing was to verify the field descriptions and identifications and obtain information for subsequent engineering evaluations. Tests performed included:

- Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216)
- Density of Soil in Place by the Drive-Cylinder Method (ASTM D2937)
- Particle-Size Analysis of Soils (ASTM D422)
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D4318)
- Unconsolidated Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Corrosivity tests were performed by an independent testing laboratory (AP Engineering & Testing, Inc. in Pomona California) in accordance with Caltrans Test Methods 643 – pH, 532 – resistivity, 417 – sulfate content, and 422 – chloride content.

The results of the laboratory tests, together with a summary sheet, are provided in Appendix B.

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7 SITE GEOLOGY AND SUBSURFACE CONDITIONS

REGIONAL GEOLOGY

Regional Geology is illustrated on Plate 6, "Regional Geology." The site is located on the eastern edge of the northern Coast Ranges Geomorphic Province, a dynamic region of California characterized by complex folding and faulting. The province is generally characterized by northwest-trending mountain ranges and intervening valleys that are a reflection of the dominant northwest structural trend of the bedrock in the region. The basement rock in the region is presumed to consist of the Franciscan Complex, a diverse group of igneous, sedimentary, and metamorphic rocks. The Franciscan Complex is part of a northwest trending belt of material immediately adjacent to the eastern edge of the San Andreas Fault system, which is located approximately 86 miles south of the site (Plate 7). The site is located approximately 74 miles northeast of the Cape Mendocino Triple Junction where the Gorda, North American, and the Pacific plates meet.

SITE GEOLOGY

Site geology is illustrated on Plate 2 of this Memorandum. The geology of the site and vicinity has been mapped by Wagner and Saucedo (1987, California Division of Mines and Geology, Geologic Map of the Weed Quadrangle, 1:250,000). Wagner and Saucedo (1987) indicate the project site and the area north, west and south of the site are underlain by the Jurassic-Cretaceous age Franciscan Complex. This bedrock is comprised of sandstone, shale and conglomerate. The area immediately east of the site is mapped as being underlain by the South Fork Mountain Schist member of the Franciscan Complex. A northwest trending bedrock fault located approximately 1000 feet east of the proposed retaining wall at its closest point separates the two Franciscan Complex units in the site vicinity. Bedrock faults are common features within the Franciscan Complex and likely occurred during the formation of the geologic units. The features are not considered to be active.

Wagner and Saucedo (1987) did not identify any landslide features at the site or within the site vicinity.

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SUBSURFACE CONDITIONS

The following table summarizes the drilling program performed for this investigation.

Table 1: Hwy 169 PM 19.47 Boring Summary

I.D.	Approx. Station	Location [1]	Depth of Boring (ft)	Surface Elev. (ft)	Date Completed	Depth to Bedrock (ft)
R-08-001	3+64	7 feet right	50.0	310+/-	4/5/08	21.5[2]
R-08-002	2+75	7 feet right	55.0	310+/-	4/3/08	22.0[2]
R-08-003	2+28	4 feet left	50.0	311+/-	4/2/08	3.5
R-08-004	1+88	5 feet right	75.0	312+/-	4/1/08	14.5[2]
R-08-005	0+38	9 feet right	65.0	315+/-	4/10/08	17.0[2]

(1) Approximate distance from highway centerline, facing in direction of increasing stationing.

(2) Bedrock is disaggregated for 1.5 to 2.5 feet below this depth

Borings R-08-002, R-08-004, and R-08-005 were drilled on the west side of the road within the main landslide mass. Fill encountered in these borings consisted of clayey sand, clayey gravel and gravel, and was between 7.5 to 15 feet thick. The fill was underlain by colluvium/landslide deposits (typically sandy clay to clayey sand) to total depths of 14.5 to 22 feet, where bedrock was encountered. Boring R-08-003 was drilled on the east side of the road, upslope of the main landslide mass. A 3.5 foot section of gravel fill was encountered overlying bedrock.

Boring R-08-001 was drilled on the west side of the road about 30 feet south of the active landslide mass. Fill consisting of clayey/silty gravel with sand was encountered to a depth of 14.5 feet. Colluvium consisting of silty/clayey gravel with sand was encountered between 14.5 and 21.5 feet. Bedrock was encountered at a depth of 21.5 feet.

At depths ranging from 3.5 to 22 feet, the borings encountered bedrock that primarily consisted of intensely fractured, low grade meta-sandstone and meta-shale. Typically, the upper surface of the bedrock consisted of a disaggregated zone that was a 1.5 to 2.5 feet thick, overlying rock that was slightly weathered and varied from very soft to moderately hard. Because the rock was intensely fractured, most samples were too disturbed for triaxial testing. Two triaxial tests that were performed on moderately disturbed samples yielded rock shear strengths of 650 and 1600 psf. The textures of the fill, landslide deposit, and decomposed bedrock are very similar and transitions should be considered approximate.

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This is a summary of conditions encountered in the five borings. More detailed information is presented on the Log of Test Borings. Variations in conditions between the borings should be expected.

Our interpretation of the subsurface geologic conditions is presented on the cross sections provided on Plates 3, 4 and 5.

8 SLOPE INCLINOMETER READINGS

A slope inclinometer was installed in Boring R-08-004. Readings were taken by Caltrans on April 16, April 23, June 5, June 24 and July 8, 2008. Readings indicate that lateral deformation is occurring at a depth of approximately 14 feet, which is approximately the top of the bedrock formation. The inclinometer indicates additional deformation at a depth of approximately 32 feet to 39 feet. This lower deformation appears to have resulted from compression of the inclinometer casing and is not interpreted as lateral movement or as a landslide shear zone. We recommend that the retaining wall be designed to support all material above the surface of the bedrock.

9 GROUNDWATER

Due to the use of drilling fluid, it was not possible to record groundwater depths at the time of drilling. Moisture/density test results indicate that most samples below the fill were saturated or nearly saturated. On June 4, June 24, and July 8, 2008, groundwater measurements were obtained by Caltrans from the slope inclinometer that was installed in Boring R-08-004. Results are tabulated below. For design purposes we recommend using a groundwater level that is three feet above the bedrock surface.

Water Level Measurements in R-08-004	
Date	Water level depth measured from top of casing (feet)
6/4/2008	17.4
6/24/2008	25.3
7/8/2008	30.5

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10 CORROSION POTENTIAL

Chemical analyses were performed on two (2) samples collected from the borings to evaluate corrosion potential of the on-site soils. Testing was performed by AP Engineering & Testing, Inc. in Pomona, California. The results of the corrosion tests are attached.

Based on the Caltrans Corrosion Guidelines (2003 version 1.0), a site is considered corrosive if one or more of the following conditions exist for the representative soil and/or water samples taken at the site: Chloride concentration is 500 ppm (0.05%) or greater, sulfate concentration is 2000 ppm (0.2%) or greater, or the pH is 5.5 or less. Based on these Guidelines and the laboratory test results, the site may be considered as non-corrosive to steel and concrete.

11 EARTHQUAKE FAULTS AND SEISMICITY

According to the Caltrans Seismic Hazard Map and Report (CSHM, Mualchin, 1996 with errata dated March 2006), the nearest fault is the Bald Mountain-Big Lagoon fault, which is located approximately 14 miles west of the site. Bald Mountain-Big Lagoon is an unknown type fault capable of generating earthquakes with a maximum credible earthquake (MCE) magnitude of 7.25. The Caltrans Seismic Hazard Map and Report (1996), locates the site on the 0.3g Peak Bedrock Acceleration (PBA) contour associated with the Bald Mountain-Big Lagoon fault. We recommend a PBA value of 0.3g and corresponding Peak Ground Acceleration (PGA) of 0.33g for the analysis and design of the proposed Highway 169 retaining wall. The PGA is estimated based on site soil class C. A portion of the Caltrans Seismic Hazard map is shown on Plate 7.

The site does not lie within an Alquist-Priolo Special Studies Zone (CDMG, 1997). No active faults are mapped crossing the project site nor do any project towards the site. The bedrock fault contact identified by Wagner and Saucedo (1987) is a common feature within the Franciscan Complex and likely occurred during the formation of the geologic units. The features are not considered to be active. As such, the possibility of primary surface rupture or deformation at the site is considered low.

12 GEOTECHNICAL AND FOUNDATION RECOMMENDATIONS

WALL LOCATION & DEPTH

Based on the field and laboratory data, it is our opinion that, without remediation, the material designated as active landslide deposits (1162) will continue to move downslope, and this will remove lateral support for the roadway.

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We recommend that a wall be designed to retain the roadway together with underlying soils. The proposed wall location is shown on Plate 2. As directed by Caltrans, the wall is located approximately 4 feet outside of the edge of pavement. As shown, the wall will extend from Station 0+10 to Station 3+50. Ends of the proposed wall terminate approximately 10 feet outside the limits of the active landslide, for a total wall length of approximately 340 feet. We recommend that the retaining wall be designed to support all material above the bedrock surface (approximately 16 to 24 feet below the roadway surface). The approximate location of the bedrock surface at the wall location is illustrated on Plate 8.

SOIL & ROCK PARAMETERS

Based on the results of our subsurface investigation and laboratory testing, subsurface material within the height of the proposed retaining wall (approximately 16 to 24 feet) consists of artificial fill and colluvium overlying intensely fractured bedrock that is mainly comprised of meta-sandstone and meta-shale/argillite. A cross section along the length of the proposed wall depicting our interpretation of the subsurface geologic conditions is presented on Plate 8. We recommend that the parameters in Table 2 be used for retaining wall design. These values represent our best estimate of actual soil properties and **do not contain a factor of safety**. Appropriate factors of safety must be applied during wall design. A surcharge pressure of 270 psf should be applied to the roadway surface behind the wall in accordance with Caltrans Bridge Design Specifications.

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Table 2: Soil & Rock Parameters for Retaining Wall Design

Type	Approximate Depth to Bottom of Layer, at Retaining Wall Location (ft)[1]	Total Unit Weight (pcf)	Buoyant Unit Weight (pcf)	Angle of Internal Friction ϕ (degrees)	Cohesion c (psf)	K_a	K_p
Fill (Qaf)	11 to 15	146	84	37[2]	0[2]	0.25[4]	0[5]
Colluvium (Qc)	16 to 24	142	80	38[2]	0[2]	0.24[4]	0[5]
Fractured Bedrock (KJfss)	NA	150	88	48[3]	0[3]	0.15[4]	2.8[6]

[1] See Plate 8 for anticipated thickness along wall.

[2] Based on correlations with field penetration test data and soil type. Strength of fill and colluvium was back-checked by assuming existing landslide has a factor of safety of ~1.0.

[3] Strength was estimated based on correlations with field blowcounts and material type, as well as observations of existing bedrock slopes.

[4] Coulomb method of analysis with $\delta = 0$. The effective width to which the pressure is applied should be in accordance with Caltrans Bridge Design Specifications, Chapter 5.

[5] Soil overlying bedrock has a factor of safety below 1.3 and should not be used in determining passive pressures.

[6] Coulomb method of analysis with $\delta = 2/3\phi$. This value assumes that the soil overlying bedrock may fail, leaving a steep bedrock slope ($35^0\pm$) below the wall.

We understand that seismic wall loads will not be used in design since this is not a "critical" structure.

HYDROSTATIC FORCES

As discussed previously, we recommend that the wall be designed for a groundwater level that is three feet above the surface of the bedrock. The wall should be provided with adequate drainage to prevent the build-up of hydrostatic pressures behind the wall. Below the base of the wall (or below the bottom of the drainage layer), design pressures (active and passive) should be based on buoyant unit weights.

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TIEBACK ANCHORS

Due to differences in strain compatibility between soil and bedrock, we recommend that tiebacks derive their support solely from the bedrock formation. The tieback unbonded length will depend on the tieback inclination, elevation, and the overall wall height.

In general, the no-load zone should be determined by the largest of the following values:

1) The distance from the back of the wall to a point that is 5 feet beyond the critical failure surface (in this case the critical failure surface is the surface of the bedrock formation).
2) The distance from the back of the wall to a point that is a distance of H/5 (H = wall height) beyond the critical failure surface.
3) 15 feet beyond the back of the wall.

The location of the unbonded zone for Sections A-A', B-B' and C-C' are shown on Plates 9, 10 and 11 respectively. For tiebacks that are located 8 feet from the top of the wall and are inclined at 20^0, the unbonded zone may be taken for all areas as 20 feet. For tiebacks that are located at other depths or inclinations, the unbonded zone should be estimated from Plates 9, 10 and 11, with a minimum length of 15 feet behind the wall.

SOLDIER PILES

Soldier piles should gain their vertical resistance from friction in the bedrock. Because of the fractured nature of the rock and the difficulty in removing slough from drilled holes, end bearing resistance should be neglected. Bedrock quality varies widely. We recommend that soldier piles be designed for a skin friction in bedrock of 1000 psf. This value is intended for use in a working stress analysis and contains a factor of safety of approximately 2.0.

Because of disturbance and deep weathering at the surface of the bedrock formation, we recommend that all soldier piling have a minimum embedment of 7.5 feet into bedrock. Deeper penetrations may be required to satisfy wall vertical or lateral loading conditions. As discussed in Section 13 of this memorandum, an embedment of 7.5 feet is expected to be adequate to force a landslide failure below the existing active failure plane and into bedrock.

The depth to in-place bedrock varies. We estimate that the depth will vary from approximately 16 feet to 24 feet at the proposed wall location. A sketch of estimated bedrock depth along the length of the wall is provided on Plate 8.

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LAGGING

The purpose of the proposed wall is to protect the road from landslide-related movements, not to stabilize the entire landslide mass. It should be assumed that the active landslide mass will continue to move on the steep slope below the wall and will eventually pull away from the downhill side of the wall. This can result in the loss of material between the pilings. To protect against loss of material, we recommend that lagging extend down to the surface of the disaggregated bedrock. As illustrated on Plate 8, this would require excavating to depths of up to approximately 16 to 24 feet below existing grades. If this is not practical, soldier pilings that are spaced at three pile diameters or closer (center to center) should develop soil arching between the pilings that will limit the internal loss of soil without the use of lagging. However, over time or in the presence of groundwater, loss of soil could still be significant and future maintenance may be necessary.

WALL BACKFILL

Backfill material behind the wall should be Class 1, Type B Permeable Material (Caltrans Standard Specifications 68-1.025). To prevent internal soil erosion, we recommend that a filter fabric (Caltrans Standard Specification 88-1.03) be placed between the Permeable fill and native soil. To prevent the accumulation of hydrostatic pressures behind the wall, we recommend that HDPE shims be installed between the lagging members. If fill is placed on the downhill side of the wall, additional drainage will be required to collect and remove water that flows through the face of the wall. This could consist of either a chimney of permeable material or a geocomposite with a collection pipe at the bottom of the wall.

To reduce backfill pressures, we recommend that any backfill placed within five feet of the wall (measured horizontally) be compacted with lightweight, hand-operated compaction equipment. Over-compaction of this fill can greatly increase wall pressures and/or deflections.

13 SLOPE STABILITY REVIEW

Kleinfelder performed slope stability analyses for the project using "Slide" version 5.03 by Rocscience. Initially, this analysis was performed to back-calculate the residual soil strength within the landslide deposits. Plate 12 presents the results of an analysis along the identified failure surface. For this analysis we used the geometry of cross section C-C' (Plate 5). The internal angle of soil friction in the fill soil that produced a factor of safety equal to one was approximately 37^0, which was used in our subsequent analyses.

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We next added the proposed retaining wall to this section and ran the model again. A 270 psf surcharge pressure was applied to the roadway area above the wall. The wall was modeled as a series of rigid piling with sufficient shear strength to force the landslide below the tips of the piling. The result of this analysis is summarized on Plate 13. Based on this analysis, with the wall socketed a minimum of 7.5 feet into bedrock, the calculated factor of safety against sliding beneath the wall was 1.3. Although a slightly lower factor of safety (1.2) was calculated for a much larger landslide beginning in the slope above the road, this area was not explored as part of this investigation and assumed subsurface properties were estimated only to provide limiting conditions for our analyses.

We checked wall design pressures by modeling a 17-foot-high wall (fully drained) with a triangular load applied to the face of the wall, see Plate 14. The force necessary to provide a factor of safety of 1.3 was calculated to be equivalent to that exerted by a fluid with a unit weight of 50 pcf, or a total load of 7225 pounds per lineal foot of wall. This calculated force was approximately 13 percent less than the design load calculated using an active pressure coefficient based on the soil properties in Table 2 (including the roadway surcharge and a factor of safety of 1.3). Based on this, we consider design in accordance with the parameters in Table 2 to be appropriate.

Finally, we checked the slope stability of material below the wall to see if removal of 18 feet of soil would improve stability of the remaining landslide deposits that are down slope of the wall. A result of this analysis is shown on Plate 15. Removal of this material improved the slope stability factor of safety only to 1.1, indicating a significant potential for the material below the wall to continue to slide. For this reason we recommend that lagging extend to the surface of the bedrock or that closely spaced soldier piling be used.

14 CONSTRUCTION CONSIDERATIONS

- Depending upon the time of year that the work is performed, groundwater may be encountered in the pile and tieback holes. Pile and tieback installations may require dewatering or the placement of concrete and grout underwater. If water is present and the holes are not dewatered, displacement of the water by means of a closed system using a concrete pump or tremie tube to place concrete and grout at the bottom of the holes will be required in conformance with the provisions in Section 51-1.10 "Concrete Deposited Under Water," of Caltrans Standard Specifications.

- Caving conditions may be encountered during drilling for piles and tiebacks, particularly if groundwater is encountered. Temporary casing, drilling under slurry, or placement of slurry cement backfill or concrete and redrilling may be required to control caving and should be performed in conformance with the provisions in Section 49-4.03 "Drilled Holes" of Caltrans Standard Specifications.

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- Vertical cut sections should not be deeper than five feet without shoring or sloping in accordance with Cal-OSHA Standards.

- Sufficient and timely observation during construction should be performed to correlate findings of the investigation with actual subsurface conditions exposed during construction.

- The contractor should research utility locations and take necessary precautions to protect-in-place or relocate utilities as applicable, prior to excavation.

- Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, nonerosive drainage devices. Any pipes or lined ditches that cross areas of landsliding (see Plate 2) are likely to be damaged by future movement. We recommend that surface drainage be collected in pipelines that are routed outside of landslide areas.

15 CLOSURE

If you have any questions regarding the information provided herein, please contact us at 707.571.1883.

REGISTERED PROFESSIONAL ENGINEER
TERENCE CRAVEN
No. 2572
Exp. 6/30/10
GEOTECHNICAL
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
WILLIAM V. McCORMICK III
No. 1673
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

for:

Terry Craven, GE 2572
Principal Geotechnical Engineer

William V. McCormick, CEG 1673
Principal Engineering Geologist

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16 ATTACHMENTS

Plates

Plate 1 Site Location
Plate 2 Site Plan
Plate 3 Section A-A'
Plate 4 Section B-B'
Plate 5 Section C-C'
Plate 6 Regional Geology
Plate 7 California Seismic Hazard Map
Plate 8 Approximate Subsurface Geology Along Wall
Plate 9 Tieback Unbonded Zone, Section A-A'
Plate 10 Tieback Unbonded Zone, Section B-B'
Plate 11 Tieback Unbonded Zone, Section C-C'
Plate 12 Slope Stability: Cross Section C-C' Back-Calculation
Plate 13 Slope Stability: Cross Section C-C' With Wall
Plate 14 Slope Stability: Cross Section C-C' Lateral Pressure
Plate 15 Slope Stability: Cross Section C-C' Downslope

Appendix A

Log of Test Borings (LOTBs, 7 pages)

Appendix B

Laboratory Test Summary
Laboratory Test Data Plates B-1 through B-4
Corrosion Test Results (AP Engineering and Testing, Inc.)

Appendix C

Slope Inclinometer Monitoring Results (1 page)

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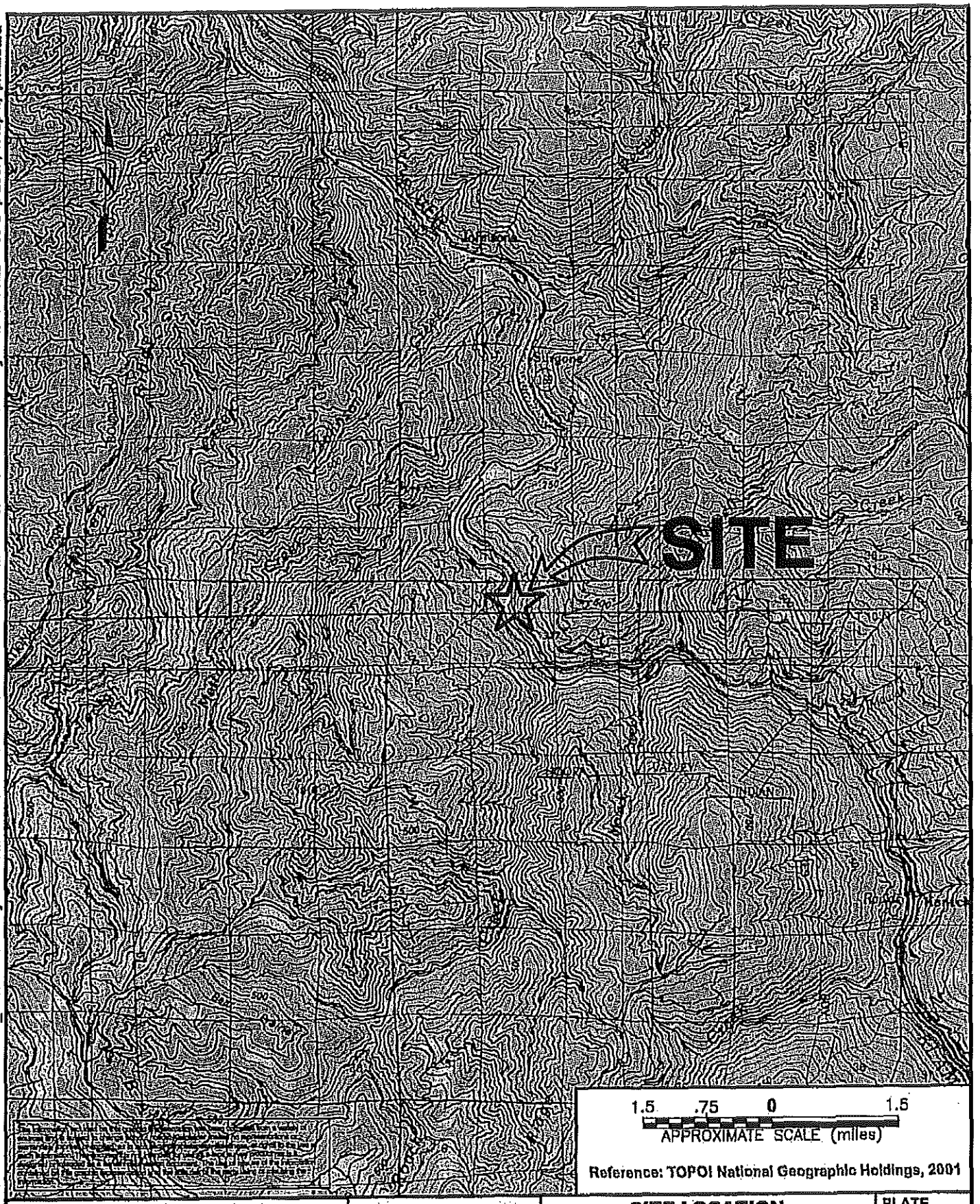
PLATES



Reference: TOPO! National Geographic Holdings, 2001

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SITE LOCATION

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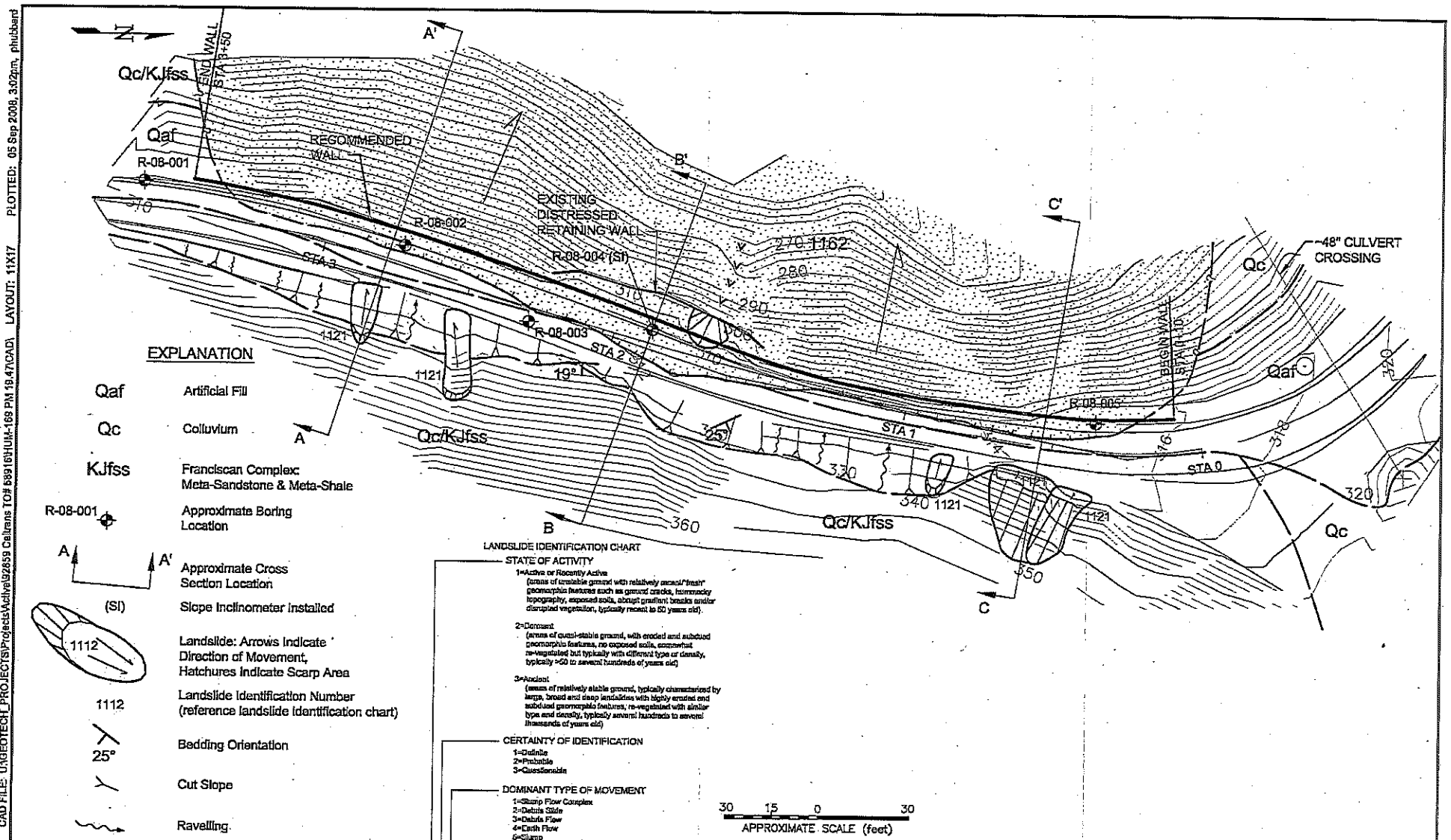
HUMBOLDT COUNTY, CALIFORNIA

PLATE

1



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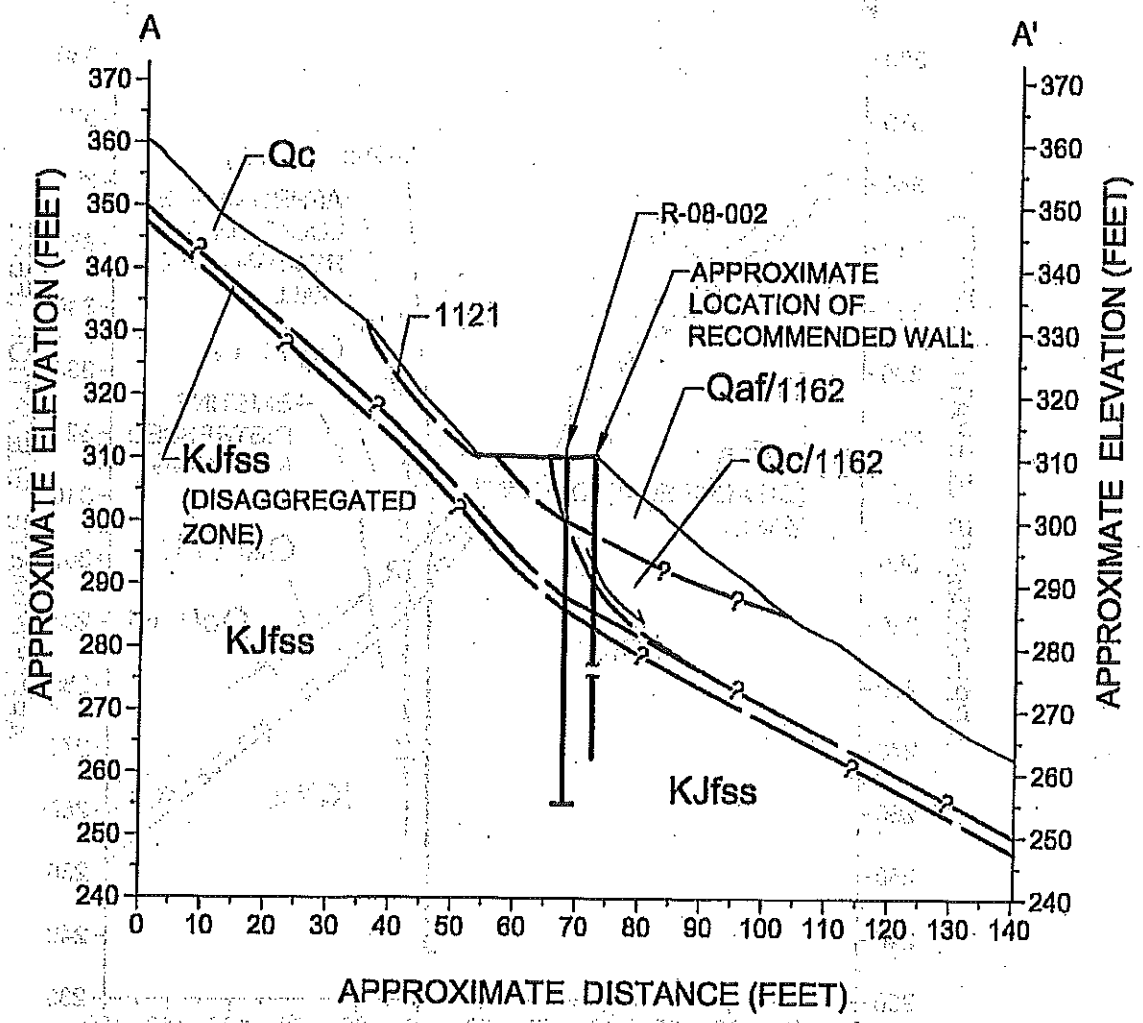

EXPLANATION

Qaf	Artificial Fill		Landslide Contact (dashed where approximate)
Qc	Colluvium		
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (reference landslide identification chart)
	Geologic Contact (dashed where approximate)		

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SECTION A - A'

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PLATE 3

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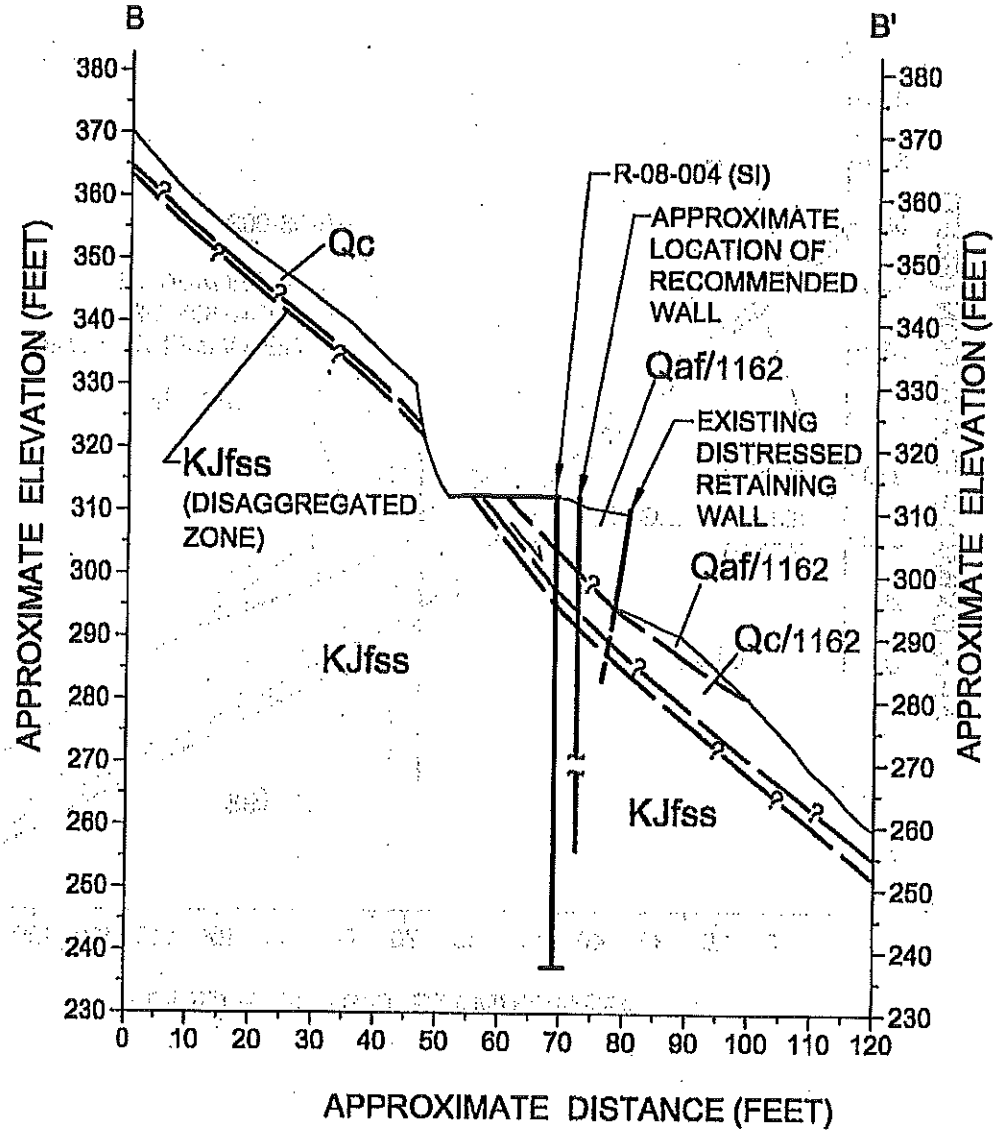

EXPLANATION

Qaf	Artificial Fill
Qc	Colluvium
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale
	Geologic Contact (dashed where approximate)
SI	Slope Inclinometer Installed
	Landslide Contact (dashed where approximate)
1162	Landslide Identification Number (reference landslide identification chart)

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SECTION B - B'

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PLATE 4

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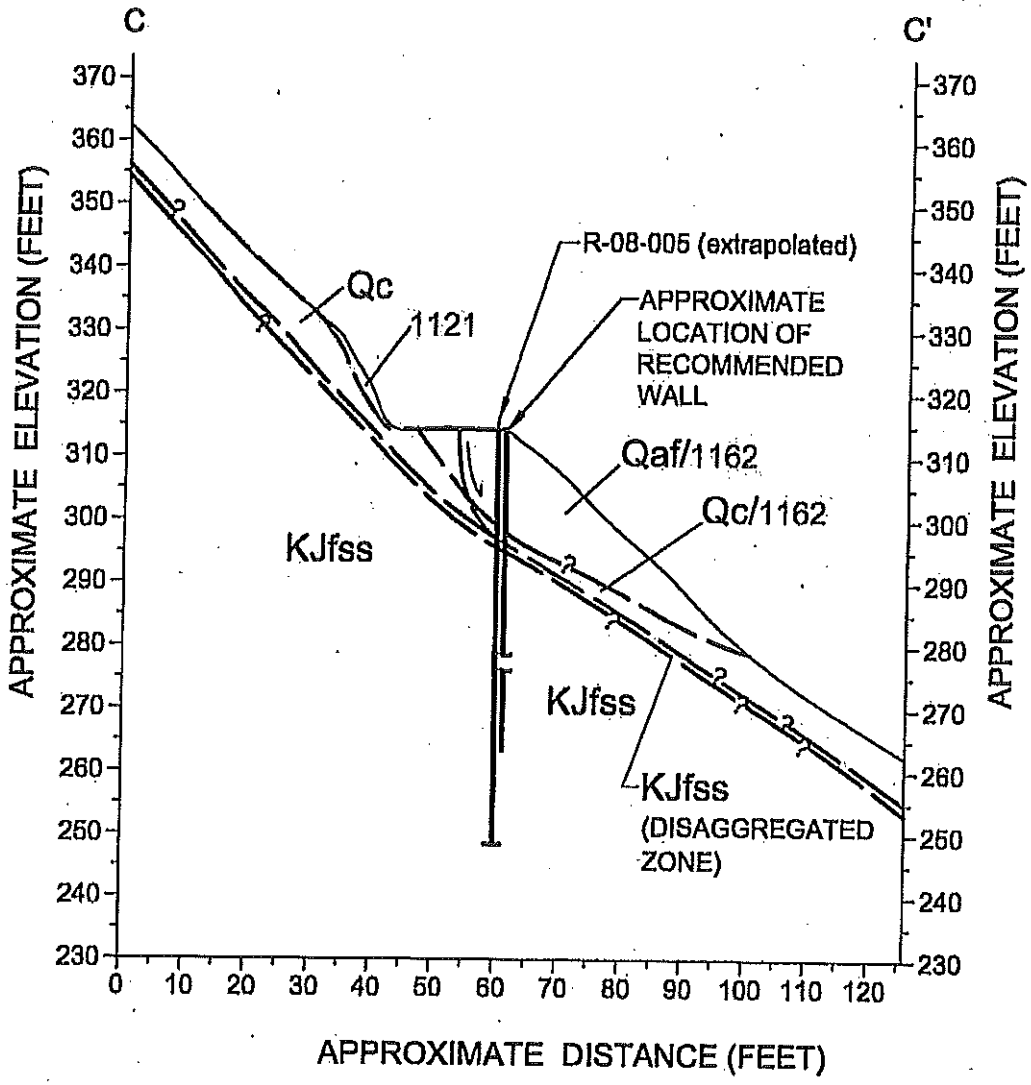

EXPLANATION

Qaf	Artificial Fill		Landslide Contact (dashed where approximate)
Qc	Colluvium		
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (reference landslide identification chart)
	Geologic Contact (dashed where approximate)		

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SECTION C - C'

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PLATE
5

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MAP SYMBOLS

Contact

Observed or approximately located; queried where gradational or inferred.

Fault

Solid where well located; dashed where approximately located or inferred; dotted where concealed by younger rocks or water; queried where continuation or existence is uncertain. U, upthrown side; D, downthrown side (relative or apparent).

Thrust fault—barbs on the upper plate. Generally dips less than 45°, but locally may have been subsequently steepened. Dashed where approximately located or inferred; dotted where concealed by younger rocks or water; queried where continuation or existence is uncertain.

Anticlinal fold

Synclinal fold

Strike and dip of beds

Strike and dip of foliation

Blueschist blocks

Joints

(Prominent joints in granitic rocks of Castle Crags.)

EXPLANATION

Fluvial deposits *(Gravel, sand, and silt)*

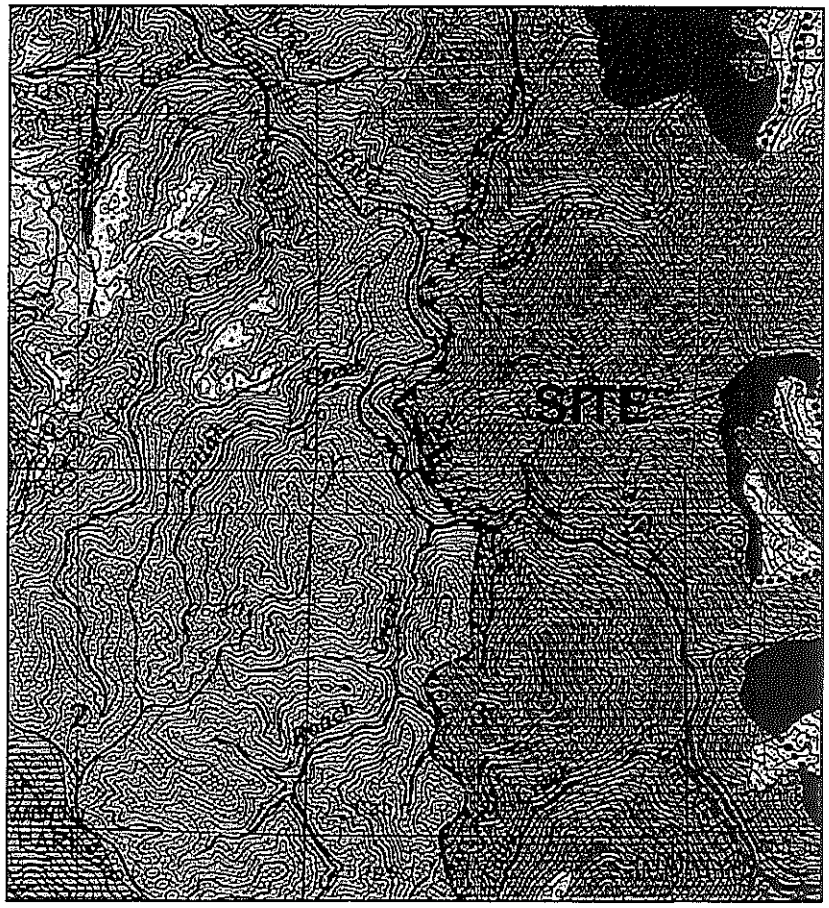
Qt — Terrace deposits

Franciscan Complex* *(ss-sandstone, shale, conglomerate; ch-chert; gs-greenstone and locally chert; mg-metagraywacke; sfm-South Fork Mountain Schist; rc-schist of Redwood Creek; ♦-blueschist blocks)*

*Horizontal pattern denotes melange terrane

Ultramafic rocks -partly to completely serpentinized

Ultramafic-gabbroic rocks



10,000 5000 0 10,000

APPROXIMATE SCALE (feet)

Reference: D.L. Wagner and G.J. Saucedo et al., 1987

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REGIONAL GEOLOGY

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PLATE 6

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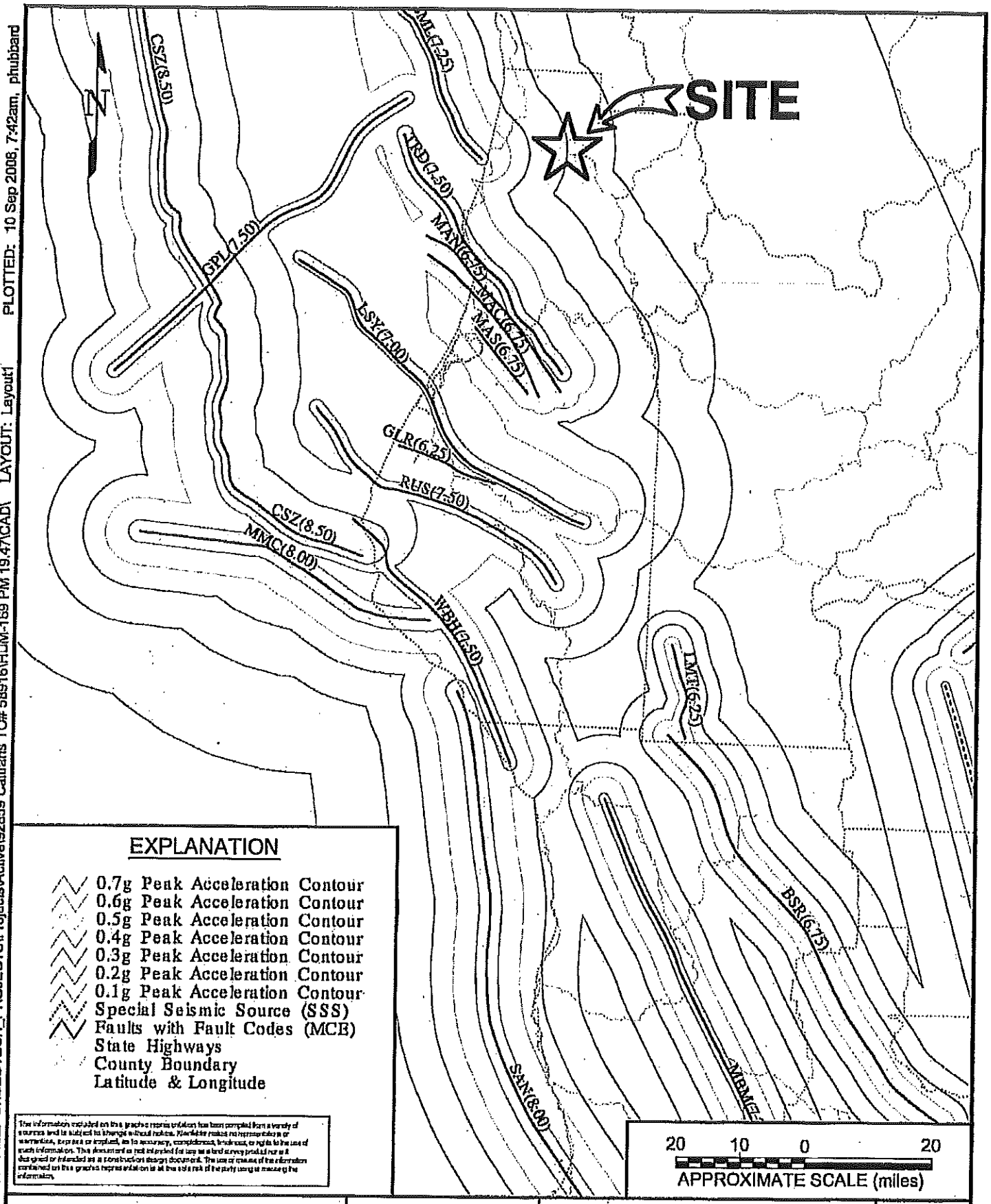

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CALIFORNIA SEISMIC HAZARD MAP (MUALCHIN 1996)

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HUMBOLDT COUNTY, CALIFORNIA

PLATE 7

PLOTTED: 10 Sep 2008, 7:42am, phubbard
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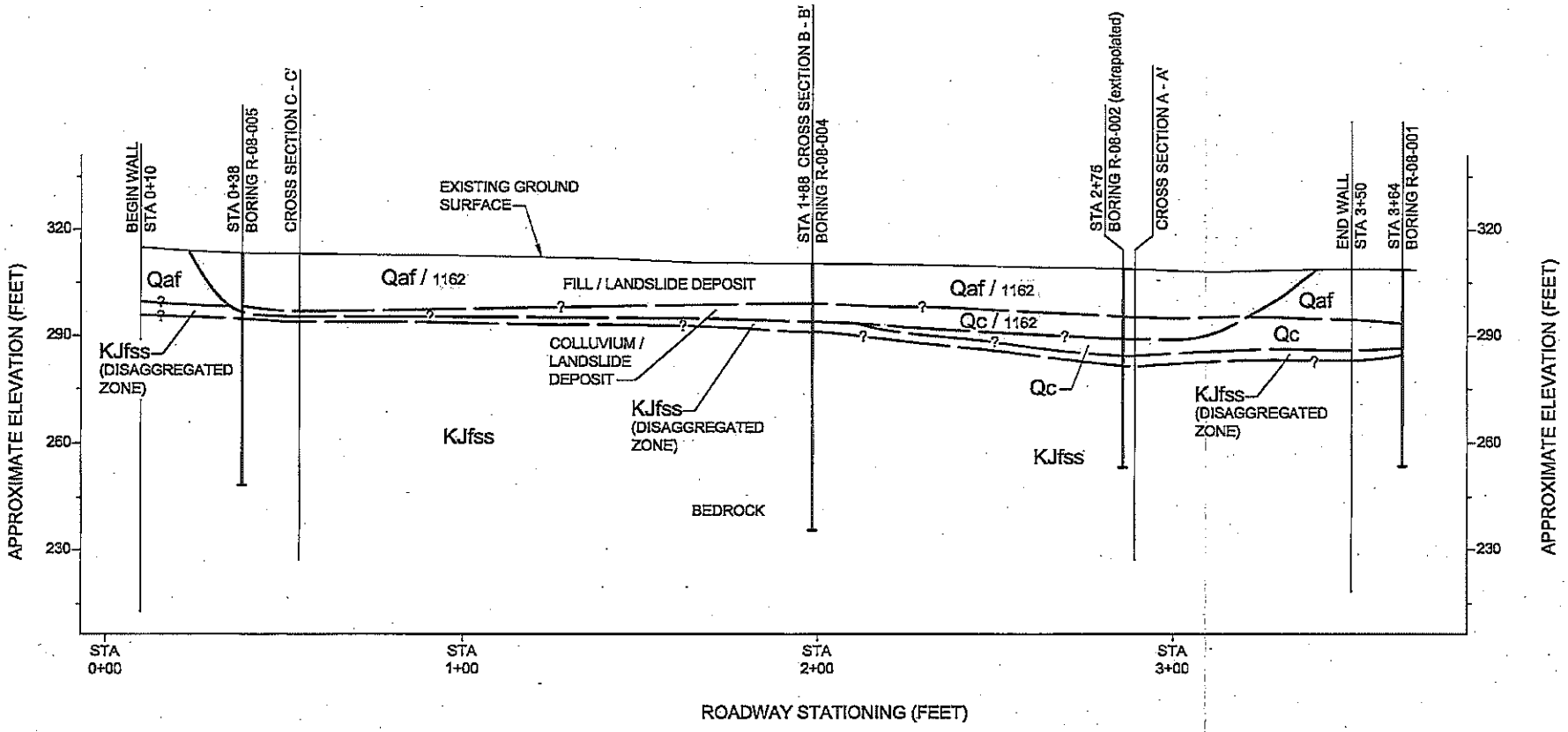

EXPLANATION

Qaf	Artificial Fill		Geologic Contact (dashed where approximate)
Qc	Colluvium		Landslide Contact (dashed where approximate)
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (see landslide chart plate 2)

NOTE:
The depth of bedrock indicated on this plate was generalized by interpolation and extrapolation between widely spaced borings. Information on bedrock depth exists only at the specific boring locations, which are offset from the proposed wall location. Bedrock depths shown should be considered approximate and variations should be expected.

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APPROXIMATE SUBSURFACE GEOLOGY ALONG WALL

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PLATE 8

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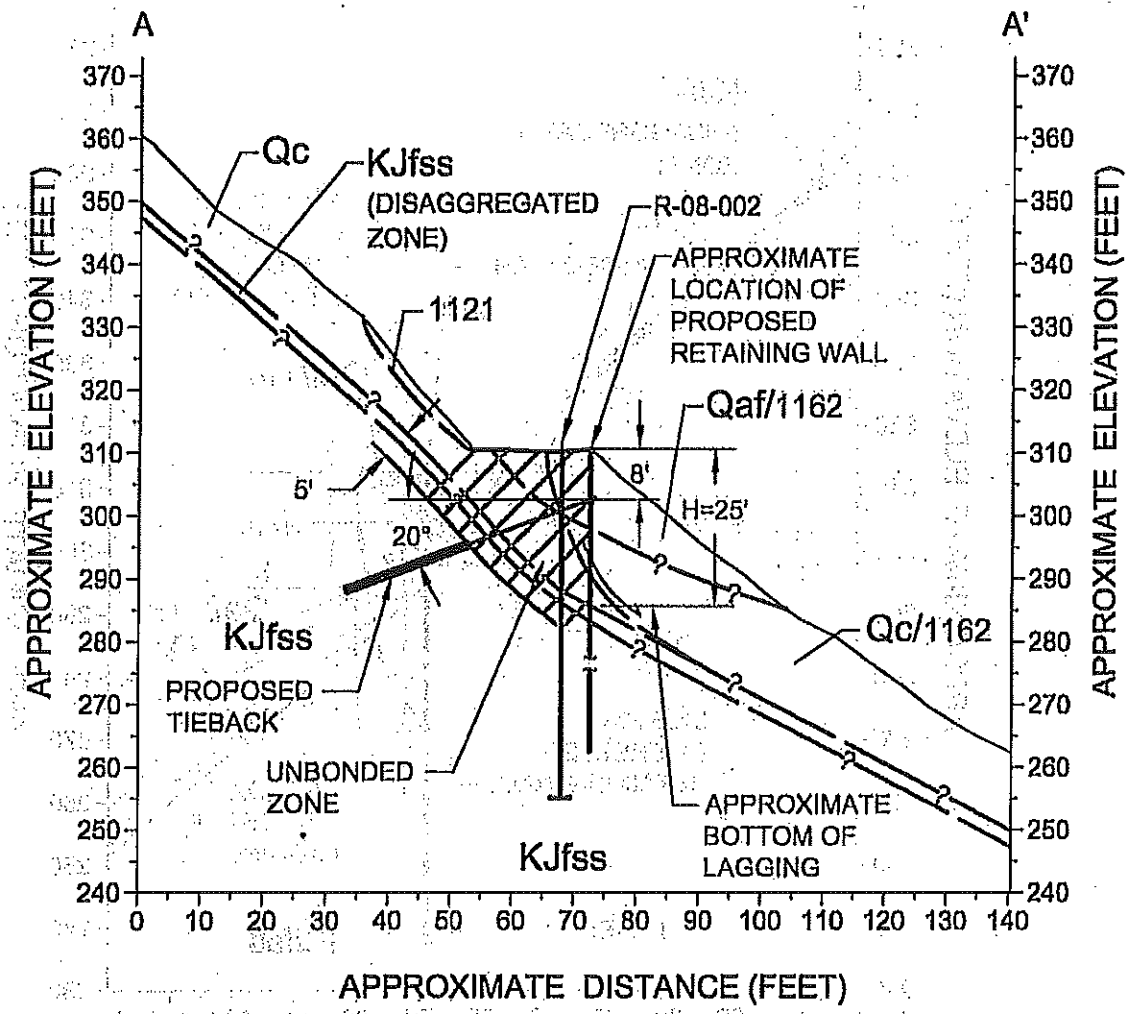

EXPLANATION

Qaf	Artificial Fill		Landslide Contact (dashed where approximate)
Qc	Colluvium		
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (reference landslide identification chart)
	Geologic Contact (dashed where approximate)		

NOTE:
In no event should unbonded length be less than 15'.

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TIEBACK UNBONDED ZONE
SECTION A - A'

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HUMBOLDT COUNTY, CALIFORNIA

PLATE
9

ATTACHED IMAGES: Images: DC_2504449.jpg
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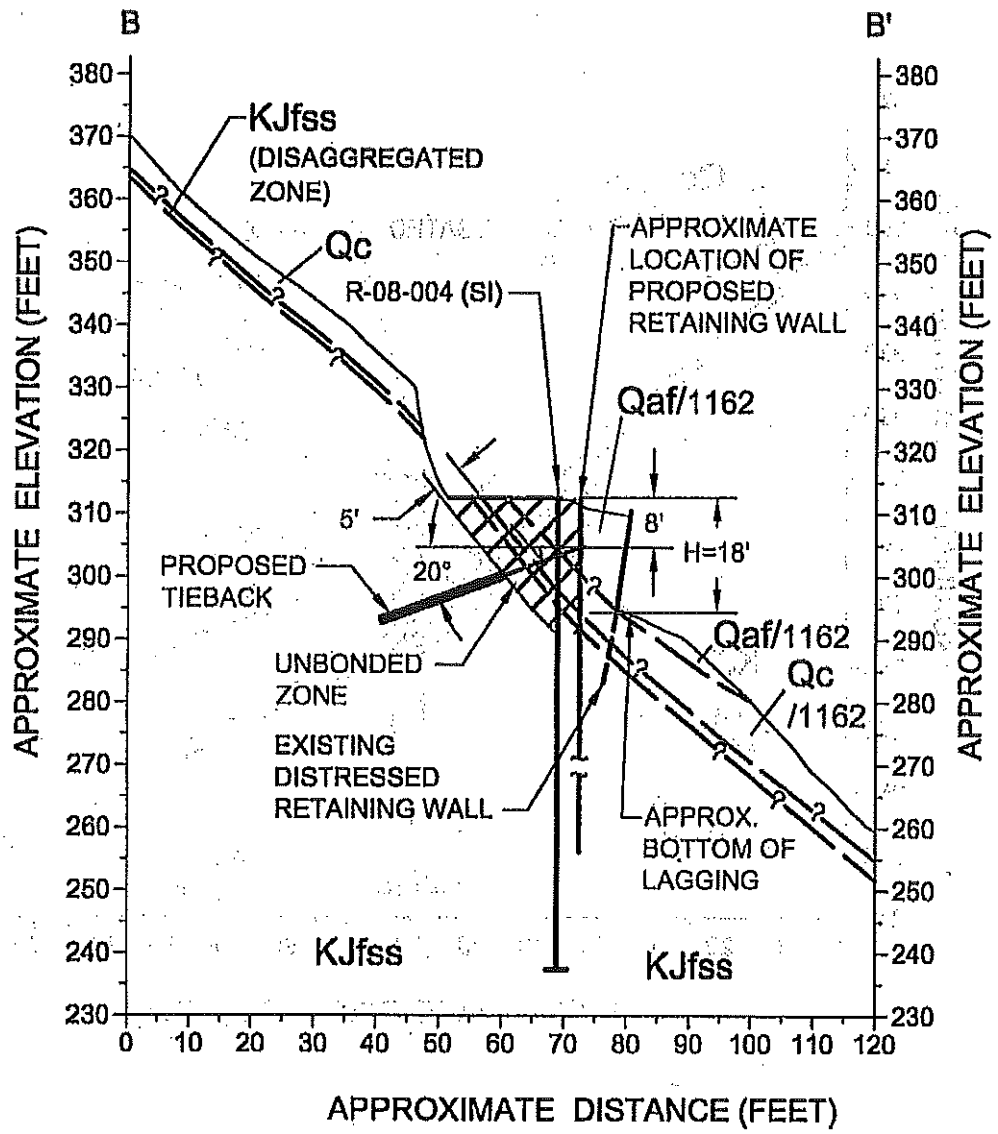

EXPLANATION

Qaf	Artificial Fill	SI	Slope Inclinometer Installed
Qc	Colluvium		Landslide Contact (dashed where approximate)
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (reference landslide identification chart)
	Geologic Contact (dashed where approximate)		

NOTE:
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APPROXIMATE SCALE (feet)

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TIEBACK UNBONDED ZONE
SECTION B - B'

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HUMBOLDT COUNTY, CALIFORNIA

PLATE
10

ATTACHED IMAGES: Images: DC_25044451.jpg
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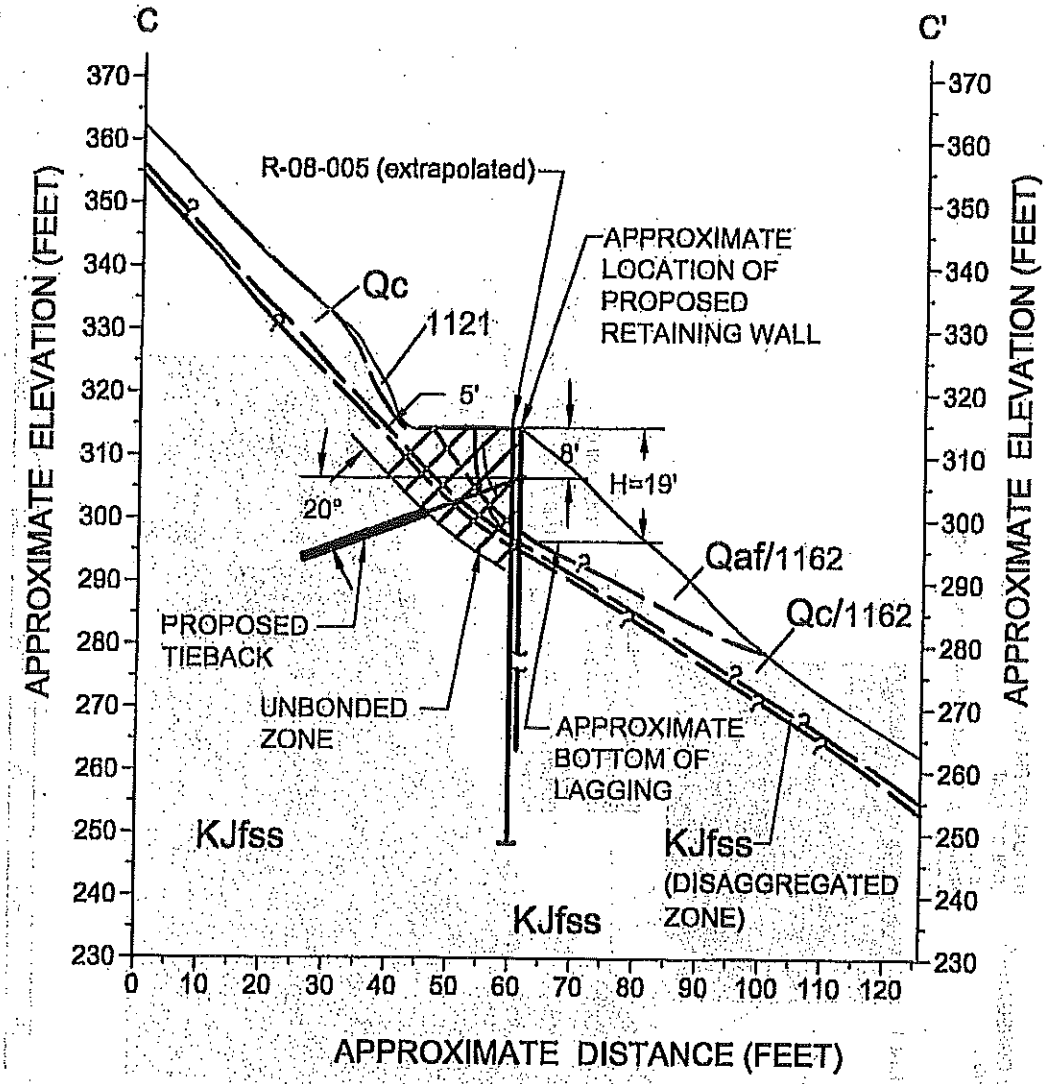

EXPLANATION

Qaf	Artificial Fill		Landslide Contact (dashed where approximate)
Qc	Colluvium		
KJfss	Franciscan Complex: Meta-Sandstone & Meta-Shale	1162	Landslide Identification Number (reference landslide identification chart)
	Geologic Contact (dashed where approximate)		

NOTE:
In no event should unbonded length be less than 15'.

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TIEBACK UNBONDED ZONE SECTION C - C'

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PLATE **11**

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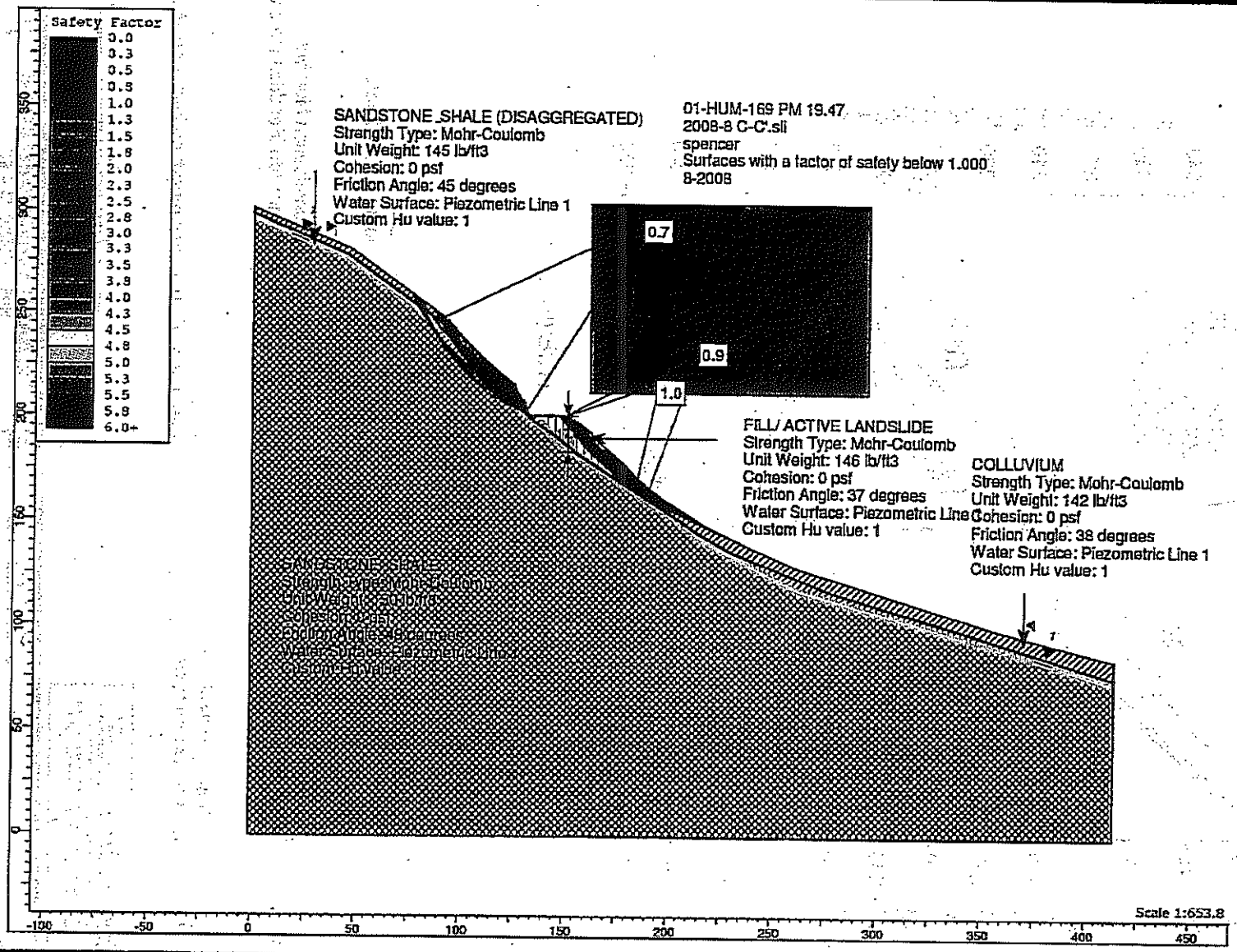

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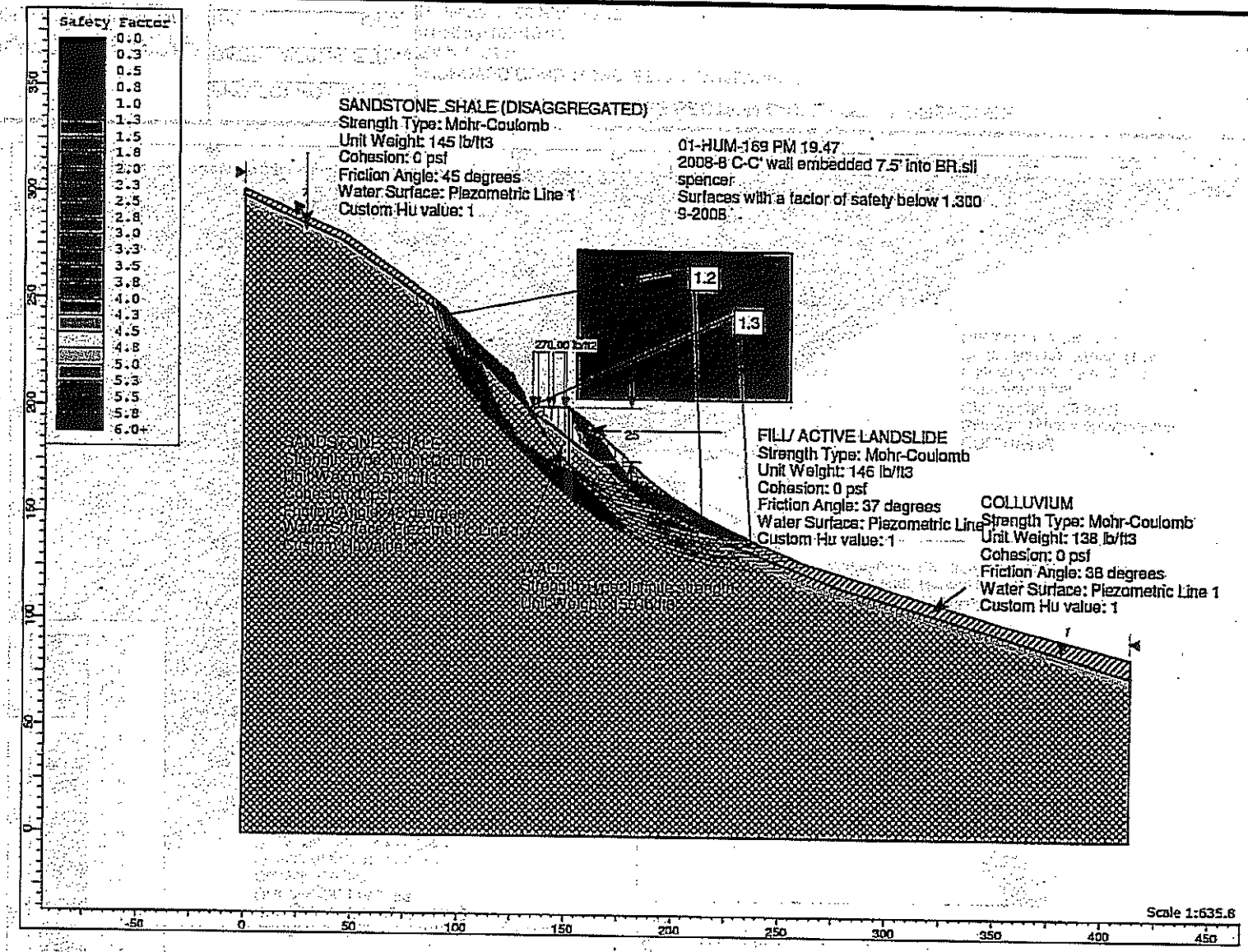
DATE:	SEPTEMBER 08
BY:	CMG
CHECKED BY:	TC

SLOPE STABILITY: CROSS SECTION C-C' BACK CALCULATION

EXISTING CONDITIONS, STATIC ANALYSIS
EA # 478301
01-HUM-169-19.47
HIGHWAY 169 P.M. 19.47
HUMBOLDT COUNTY, CALIFORNIA

PLATE

12



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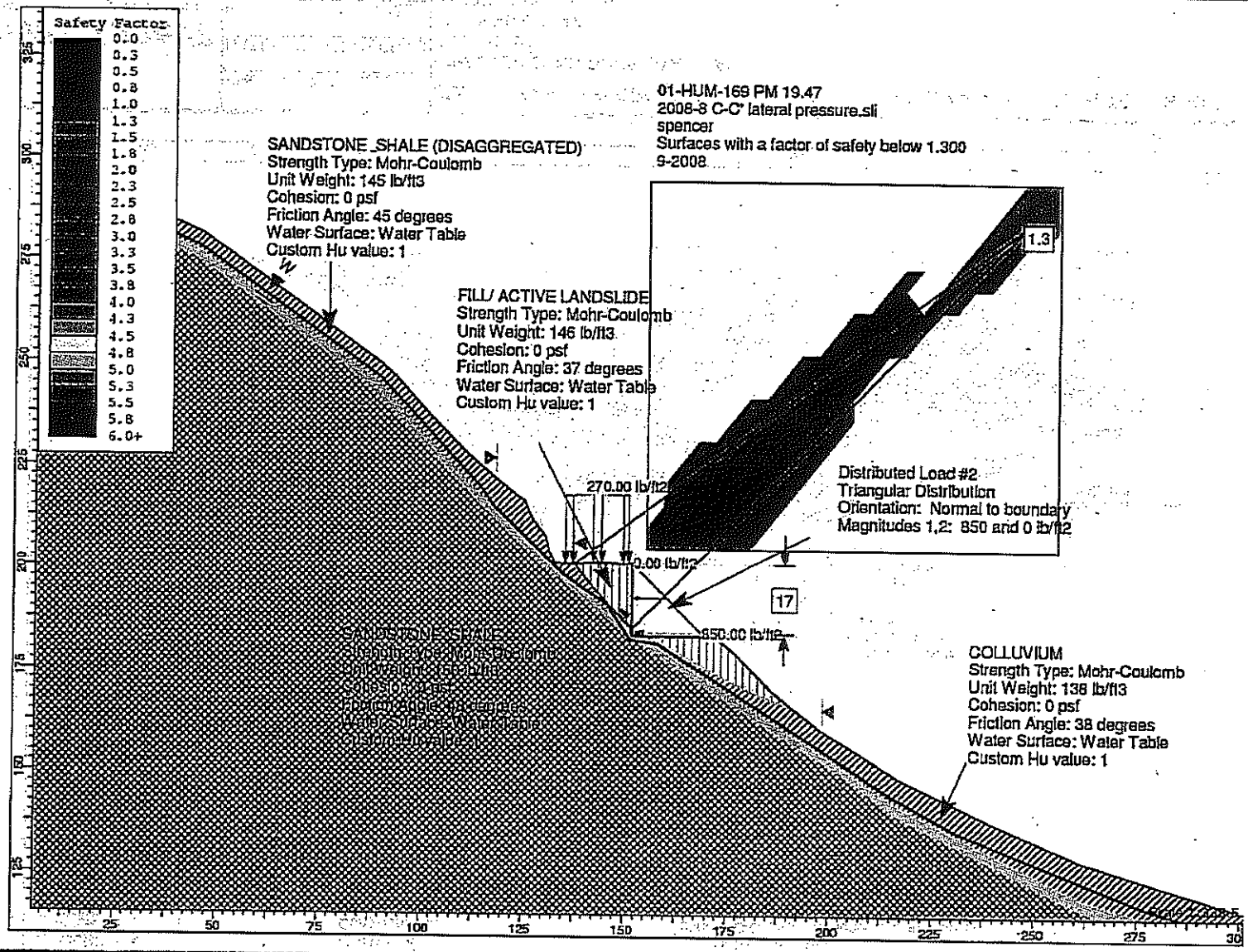
PROJECT NO.:	92859
DATE:	SEPTEMBER 08
BY:	CMG
CHECKED BY:	TC

SLOPE STABILITY: CROSS SECTION C-C' WITH WALL 7.5' INTO COMPETENT ROCK

IMPROVED CONDITIONS, STATIC ANALYSIS
EA # 478301
01-HUM-169-19.47
HIGHWAY 169 P.M. 19.47
HUMBOLDT COUNTY, CALIFORNIA

PLATE
13



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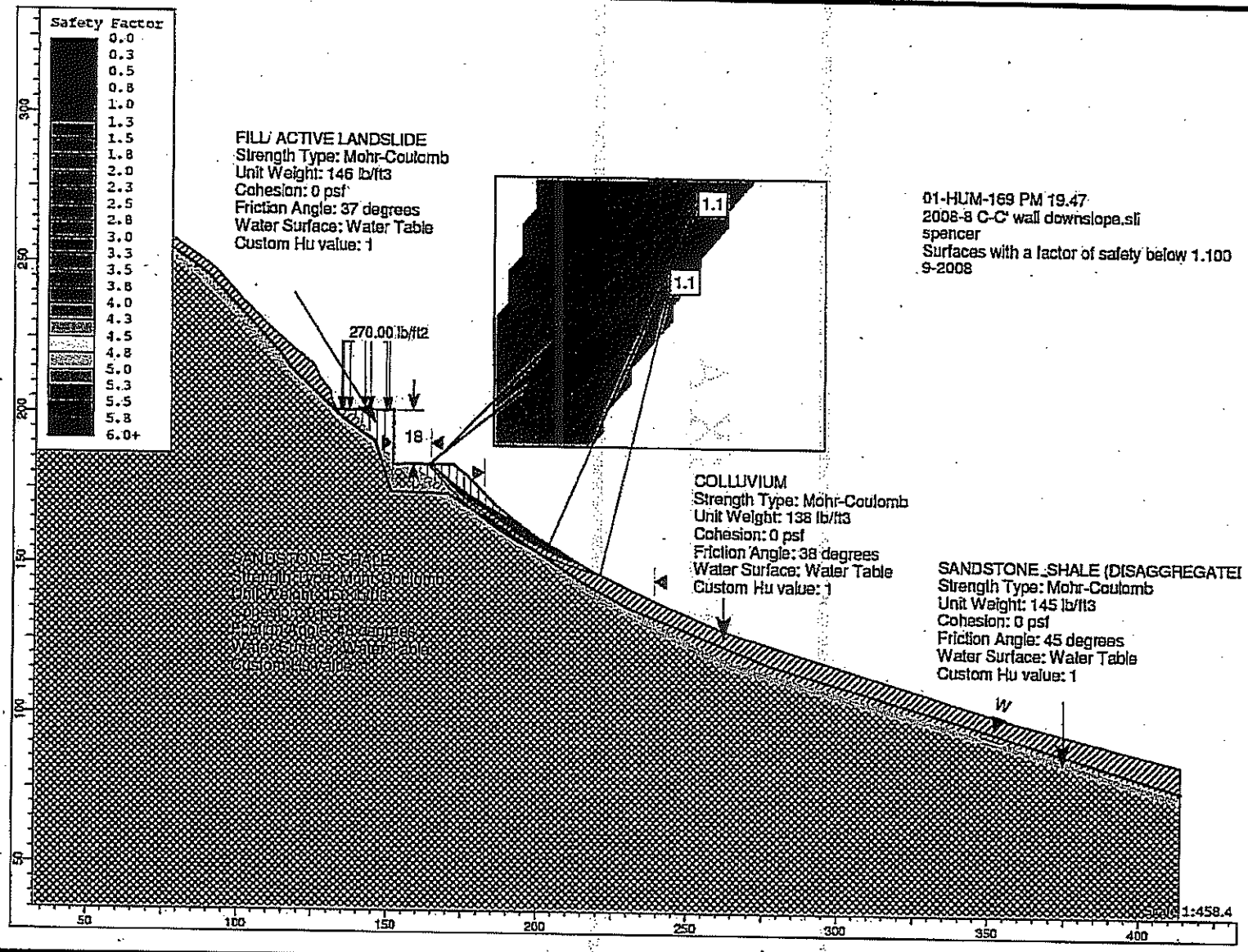
Bright People. Right Solutions.

PROJECT NO.:	92859
DATE:	SEPTEMBER 08
BY:	CMG
CHECKED BY:	TC

SLOPE STABILITY: CROSS SECTION C-C' LATERAL PRESSURE

IMPROVED CONDITIONS, STATIC ANALYSIS
EA # 478301
01-HUM-169-19.47
HIGHWAY 169 P.M. 19.47
HUMBOLDT COUNTY, CALIFORNIA

PLATE
14



KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	92859
DATE:	SEPTEMBER 08
BY:	CMG
CHECKED BY:	TC

SLOPE STABILITY: CROSS SECTION C-C' DOWNSLOPE

IMPROVED CONDITIONS, STATIC ANALYSIS
EA # 478301
01-HUM-169-19.47
HIGHWAY 169 P.M. 19.47
HUMBOLDT COUNTY, CALIFORNIA

PLATE
15

KLEINFELDER
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APPENDIX A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
01	Hum	169	19.47		

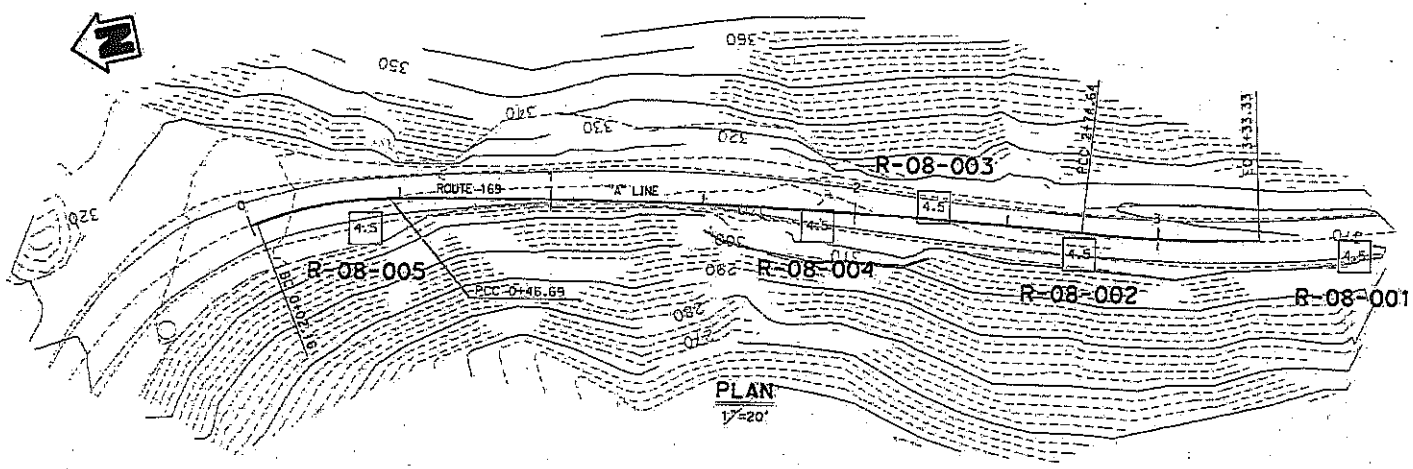
REGISTERED GEOLOGIST 8-25-08 DATE

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED GEOLOGIST MICHAEL V. DECARLO III No. 1675 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407



Notes:

1. 2" samples were taken using a modified California split-barrel sampler with an inside diameter (I.D.) of 2" and an outside diameter (O.D.) of 2½".
2. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (I.D.) of 1.4" and an outside diameter (O.D.) of 2".
3. An automatic hammer (140 lb) with a 30" drop was used to advance the sampler.
4. Blowcounts noted for boring are field blowcounts and have not been corrected.
5. Blowcounts 50/5 means 50 blows per 5" penetration.
6. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

BENCHMARKS

STATION	N	E	ELEV (FT)	DESCRIPTION

SURVEY CONTROL
1. Coordinates bearing and distances are based on the California State Plane Coordinate system of NAD 83 (1986). Elevations are based on NAVD88.

DESIGN OVERSIGHT ENGINEER: SIGN OFF DATE:
FUNCTIONAL SUPERVISOR
NAME:
DRAWN BY: A. Sanchez
CHECKED BY: E. Johnson
FIELD INVESTIGATION BY: KLEINFELDER, April 2008
PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
PROJECT ENGINEER
BRIDGE NO.
POST MILES 19.47

RETAINING WALL @ POST MILE 19.5
LOG OF TEST BORINGS 1 of 7

DGS CIVIL LOG OF TEST BORINGS SHEET
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
CU
EA 470301
IFILE => 9REQUEST
DIRECTORY PRINTS BEARING EARLIER REVISION DATES
REVISION DATES
SHEET OF

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 7

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
01	Hum	169	19.47		

REGISTERED GEOLOGIST 8-25-08 DATE

PLANS APPROVAL DATE

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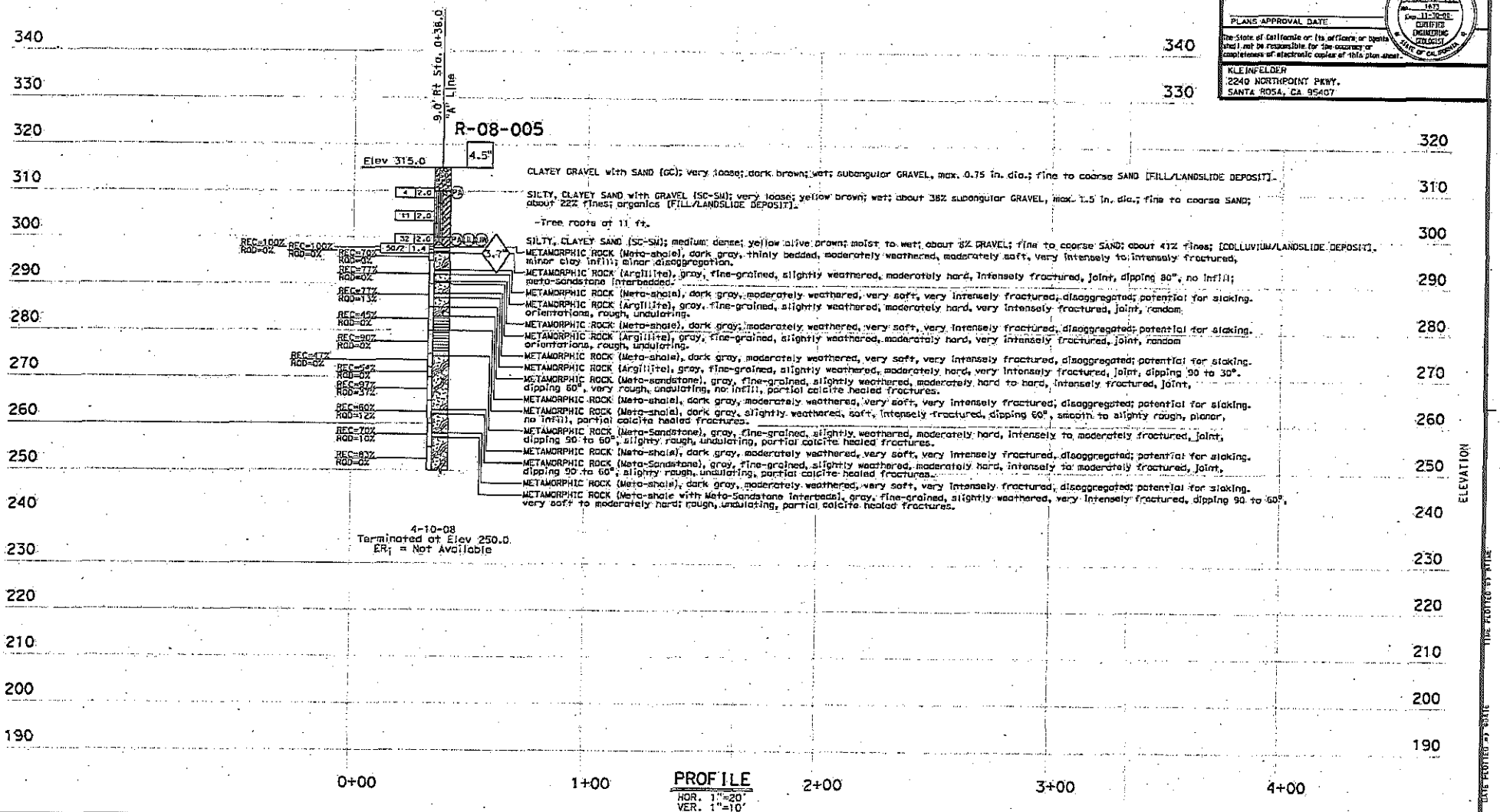
REGISTERED GEOLOGIST WILLIAM V. MCCRACKEN III 1673 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407



PROFILE
HOR. 1"=20'
VER. 1"=10'

DESIGN OVERSIGHT ENGINEER:	SIGN OFF DATE:		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PROJECT ENGINEER	BRIDGE NO.	RETAINING WALL @ POST MILE 19.5
FUNCTIONAL SUPERVISOR	DRAWN BY: A. Sanchez	FIELD INVESTIGATION BY:			POST MILES 19.47	LOG OF TEST BORINGS 2 of 7
NAME:	CHECKED BY: E. Johnson	E. Johnson, April 2008		CU EA 478301		

08R CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

FILE => SHEQUEST

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 7

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
01	Hum.	169	19.47		

REGISTERED GEOLOGIST — DATE 9-25-08

PLANS APPROVAL DATE

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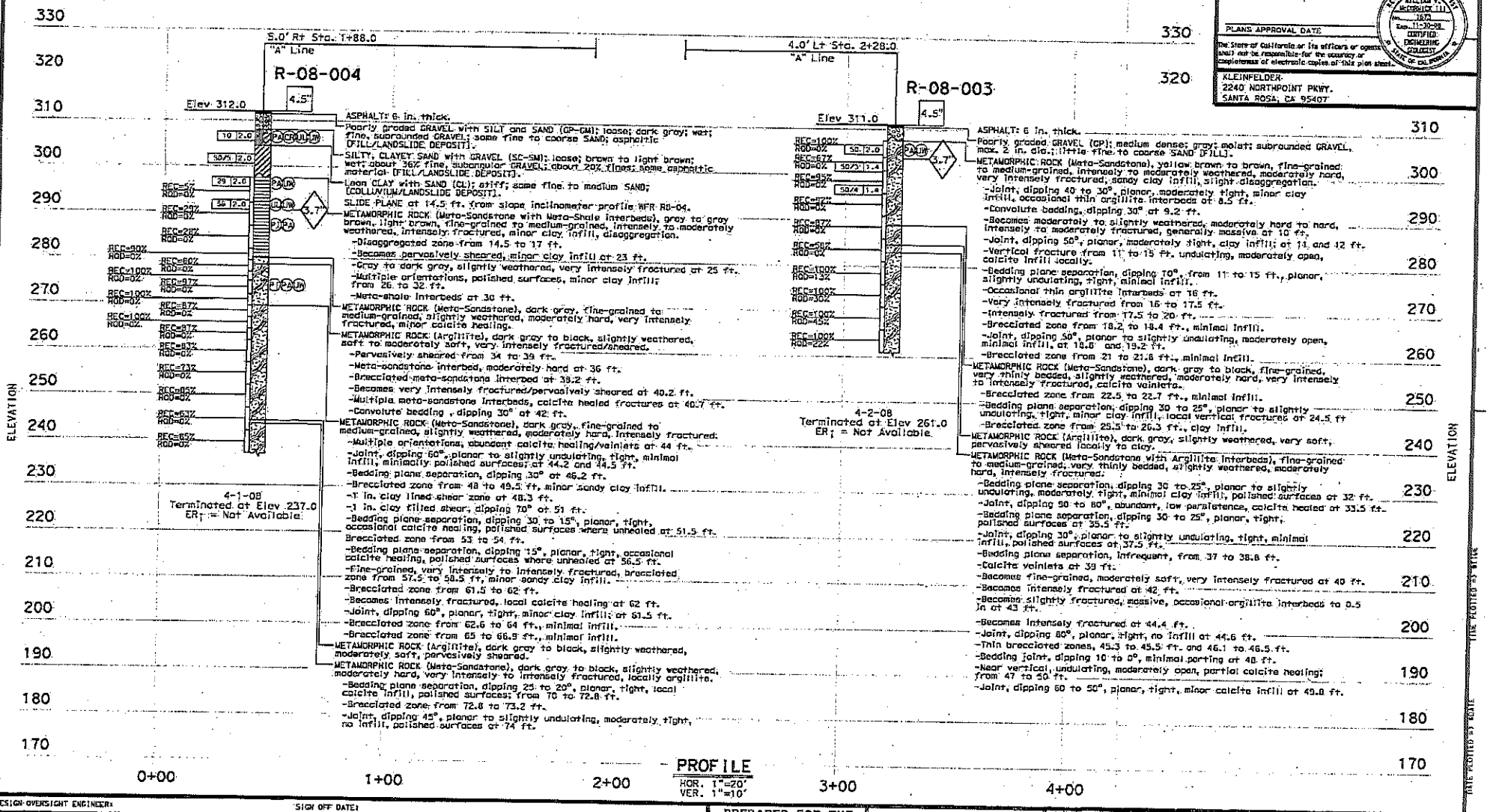
REGISTERED GEOLOGIST WILLIAM H. MCCRUICK III 1673 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407



ASPHALT: 6 in. thick.
Poorly graded GRAVEL with SILT and SAND (GP-GM); loose; dark gray; wet; fine, subrounded GRAVEL; some fine to coarse SAND; asphaltic [FILL/LANDSLIDE DEPOSIT].
SILTY, CLAYEY SAND with GRAVEL (SC-SM); loose; brown to light brown; wet; about 36% fine, subangular GRAVEL; about 20% fines; some asphaltic material [FILL/LANDSLIDE DEPOSIT].
Lean CLAY with SAND (CL); stiff; some fine to medium SAND; [COLLUVIUM/LANDSLIDE DEPOSIT].
SLIDE PLANE at 14.5 ft. from slope inclinometer profile WFR R8-04.
METAMORPHIC ROCK (Meta-Sandstone with Meta-Shale interbeds), gray to gray brown, light brown, fine-grained to medium-grained, intensely to moderately weathered, intensely fractured, minor clay infill, disaggregation.
-Disaggregated zone from 14.5 to 17 ft.
-Becomes pervasively sheared, minor clay infill at 23 ft.
-Gray to dark gray, slightly weathered, very intensely fractured at 25 ft.
-Multiple orientations, polished surfaces, minor clay infill; from 26 to 32 ft.
-Meta-shale interbeds at 30 ft.
METAMORPHIC ROCK (Meta-Sandstone), dark gray, fine-grained to medium-grained, slightly weathered, moderately hard, very intensely fractured, minor calcite healing.
METAMORPHIC ROCK (Argillite), dark gray to black, slightly weathered, soft to moderately soft, very intensely fractured/sheared.
-Pervasively sheared from 34 to 39 ft.
-Meta-sandstone interbed, moderately hard at 36 ft.
-Brecciated meta-sandstone interbed at 38.2 ft.
-Becomes very intensely fractured/pervasively sheared at 40.2 ft.
-Multiple meta-sandstone interbeds, calcite healed fractures at 40.7 ft.
-Convolute bedding , dipping 30° at 42 ft.
METAMORPHIC ROCK (Meta-Sandstone), dark gray, fine-grained to medium-grained, slightly weathered, moderately hard, intensely fractured:
-Multiple orientations, abundant calcite healing/veinlets at 44 ft.
-Joint, dipping 60°, planar to slightly undulating, tight, minimal infill, minimally polished surfaces; at 44.2 and 44.5 ft.
-Bedding plane separation, dipping 30° at 46.2 ft.
-Brecciated zone from 48 to 49.5 ft, minor sandy clay infill.
-1 in. clay lined shear zone at 48.3 ft.
-1 in. clay filled shear, dipping 70° at 51 ft.
-Bedding plane separation, dipping 30 to 15°, planar, tight, occasional calcite healing, polished surfaces where unhealed at 51.5 ft.
Brecciated zone from 53 to 54 ft.
-Bedding plane separation, dipping 15°, planar, tight, occasional calcite healing, polished surfaces where unhealed at 56.5 ft.
-Fine-grained, very intensely to intensely fractured, brecciated zone from 57.5 to 58.5 ft, minor sandy clay infill.
-Brecciated zone from 61.5 to 62 ft.
-Becomes intensely fractured, local calcite healing at 62 ft.
-Joint, dipping 60°, planar, tight, minor clay infill; at 61.5 ft.
-Brecciated zone from 62.6 to 64 ft., minimal infill.
-Brecciated zone from 65 to 66.9 ft., minimal infill.
METAMORPHIC ROCK (Argillite), dark gray to black, slightly weathered, moderately soft, pervasively sheared.
METAMORPHIC ROCK (Meta-Sandstone), dark gray to black, slightly weathered, moderately hard, very intensely to intensely fractured, locally argillite.
-Bedding plane separation, dipping 25 to 20°, planar, tight, local calcite infill, polished surfaces; from 70 to 72.8 ft.
-Brecciated zone from 72.8 to 73.2 ft.
-Joint, dipping 45°, planar to slightly undulating, moderately tight, no infill, polished surfaces at 74 ft.

ASPHALT: 6 in. thick.
Poorly graded GRAVEL (GP); medium dense; gray; moist; subrounded GRAVEL, max. 2 in. dia.; little fine to coarse SAND [FILL].
METAMORPHIC ROCK (Meta-Sandstone), yellow brown to brown, fine-grained to medium-grained, intensely to moderately weathered, moderately hard, very intensely fractured, sandy clay infill, slight disaggregation.
-Joint, dipping 40 to 30°, planar, moderately tight, minor clay infill, occasional thin argillite interbeds at 8.5 ft.
-Convolute bedding, dipping 30° at 9.2 ft.
-Becomes moderately to slightly weathered, moderately hard to hard, intensely to moderately fractured, generally massive at 10 ft.
-Joint, dipping 50°, planar, moderately tight, clay infill; at 11 and 12 ft.
-Vertical fracture from 11 to 15 ft. undulating, moderately open, calcite infill locally.
-Bedding plane separation, dipping 70°, from 11 to 15 ft., planar, slightly undulating, tight, minimal infill.
-Occasional thin argillite interbeds at 16 ft.
-Very intensely fractured from 16 to 17.5 ft.
-Intensely fractured from 17.5 to 20 ft.
-Brecciated zone from 18.2 to 18.4 ft., minimal infill.
-Joint, dipping 50°, planar to slightly undulating, moderately open, minimal infill, at 18.8 and 19.2 ft.
-Brecciated zone from 21 to 21.8 ft., minimal infill.
METAMORPHIC ROCK (Meta-Sandstone), dark gray to black, fine-grained, very thinly bedded, slightly weathered, moderately hard, very intensely to intensely fractured, calcite veinlets.
-Brecciated zone from 22.5 to 22.7 ft., minimal infill.
-Bedding plane separation, dipping 30 to 25°, planar to slightly undulating, tight, minor clay infill, local vertical fractures at 24.5 ft
-Brecciated zone from 25.5 to 26.3 ft., clay infill.
METAMORPHIC ROCK (Argillite), dark gray, slightly weathered, very soft, pervasively sheared locally to clay.
METAMORPHIC ROCK (Meta-Sandstone with Argillite interbeds), fine-grained to medium-grained, very thinly bedded, slightly weathered, moderately hard, intensely fractured:
-Bedding plane separation, dipping 30 to 25°, planar to slightly undulating, moderately tight, minimal clay infill, polished surfaces at 32 ft.
-Joint, dipping 90 to 80°, abundant, low persistence, calcite healed at 33.5 ft.
-Bedding plane separation, dipping 30 to 25°, planar, tight, polished surfaces at 35.5 ft.
-Joint, dipping 30°, planar to slightly undulating, tight, minimal infill, polished surfaces at 37.5 ft.
-Bedding plane separation, infrequent, from 37 to 38.8 ft.
-Calcite veinlets at 39 ft.
-Becomes fine-grained, moderately soft, very intensely fractured at 40 ft.
-Becomes intensely fractured at 42 ft.
-Becomes slightly fractured, massive, occasional argillite interbeds to 0.5 in at 43 ft.
-Becomes intensely fractured at 44.4 ft.
-Joint, dipping 80°, planar, tight, no infill at 44.6 ft.
-Thin brecciated zones, 45.3 to 45.5 ft. and 46.1 to 46.5 ft.
-Bedding joint, dipping 10 to 0°, minimal parting at 48 ft.
-Near vertical, undulating, moderately open, partial calcite healing; from 47 to 50 ft.
-Joint, dipping 60 to 50°, planar, tight, minor calcite infill at 49.8 ft.

PROFILE
HOR. 1"=20'
VER. 1"=10'

DESIGN OVERSIGHT ENGINEER:	SIGN OFF DATE:			PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PROJECT ENGINEER	BRIDGE NO.	RETAINING WALL @ POST MILE 19.5
FUNCTIONAL SUPERVISOR	DRAWN BY: A. Sanchez	FIELD INVESTIGATION BY: J. Richmond, April 2008				POST MILES 19.47	LOG OF TEST BORINGS 3 of 7
NAME:	CHECKED BY: E. Johnson						
DES CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3				CU EA 478301	DISREGARD PRINTS BEARING EARLIER REVISION DATES	

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 7

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Hum	169	19.47		

REGISTERED GEOLOGIST — DATE 8-25-08

PLANS APPROVAL DATE

REGISTERED GEOLOGIST WILLIAM V. MCCORMICK III No. 1673 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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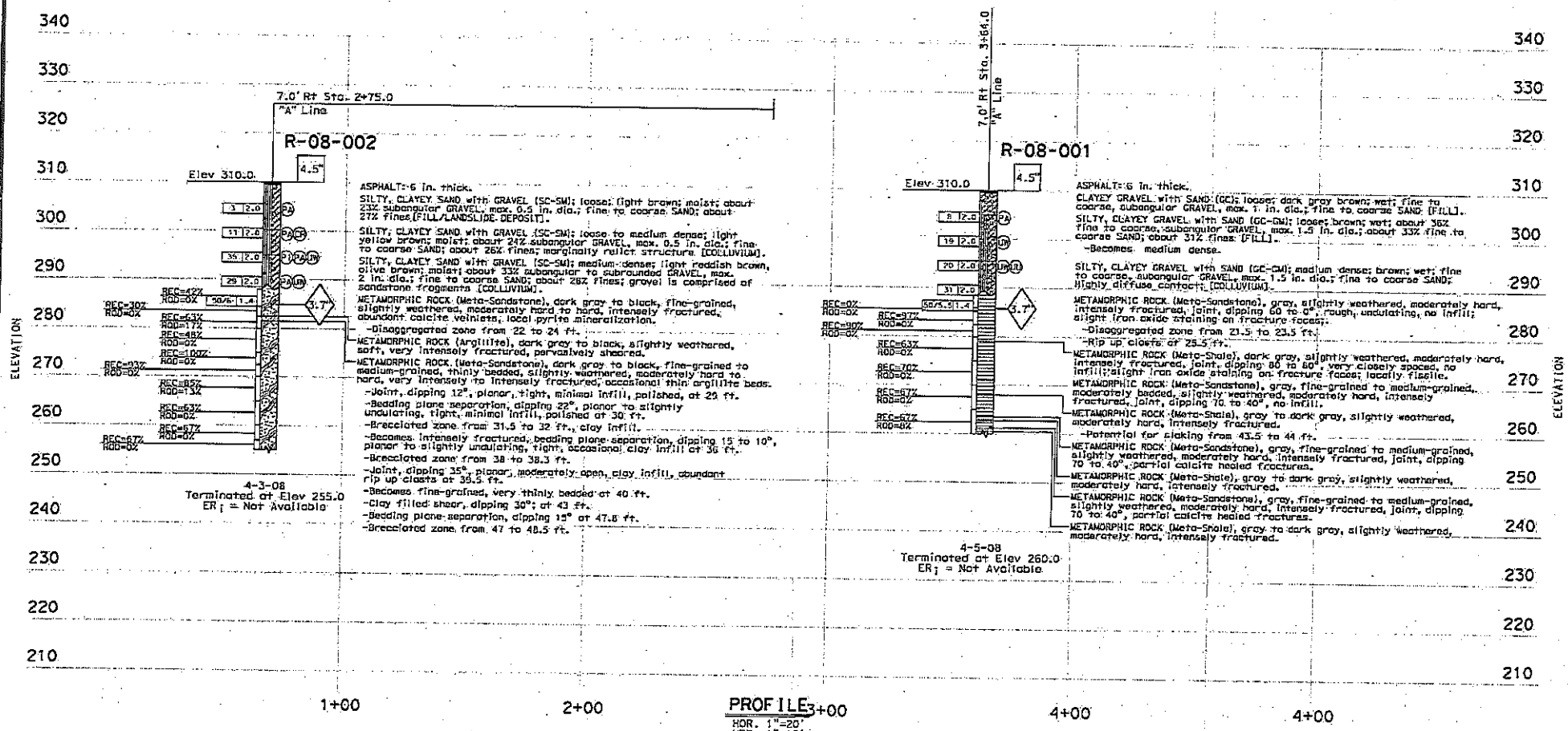
KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407



DESIGN OVERSIGHT ENGINEER:	SIGN OFF DATE:		
FUNCTIONAL SUPERVISOR	DRAWN BY: A. Sanchez	FIELD INVESTIGATION BY:	
NAME:	CHECKED BY: E. Johnson	J. Richmond, E. Johnson, April 2008	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

CU
E.A. 478301
(FILE => BREQUEST)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

DGS CIVIL LOG OF TEST BORINGS SHEET

RETAINING WALL @ POST MILE 19.5

LOG OF TEST BORINGS 4 of 7

POST MILES 19.47

DISREGARD PRINTS DRAWING EARLIER REVISION DATES

REVISION DATES

USERNAME => RASCH

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
01	Hum	169	19.47		

REGISTERED GEOLOGIST 8-25-08 DATE

PLANS APPROVAL DATE

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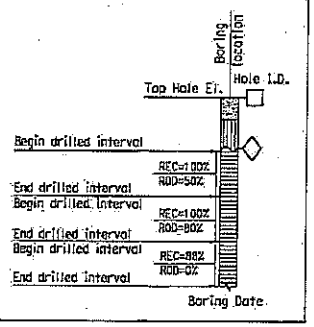
REGISTERED GEOLOGIST WILLIAM V. McCOURTNEY III No. 1672 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (inches)}}{\text{Total length of core run (inches)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 4''}{\text{Total length of core run (inches)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (PSI)
Extremely Strong	> 30,000
Very Strong	14,500 - 30,000
Strong	7,000 - 14,500
Medium Strong	3,500 - 7,000
Weak	700 - 3,500
Very Weak	150 - 700
Extremely Weak	< 150

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 10 ft
Very thickly bedded	3 to 10 ft
Thickly bedded	1 to 3 ft
Moderately bedded	3-5/8" to 1 ft
Thinly bedded	1-1/4" to 3-5/8"
Very thinly bedded	3/8" to 1-1/4"
Laminated	Less than 3/8"

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 3 feet.
Slightly fractured	Lengths from 1 to 3 feet with few lengths less than 1 foot or greater than 3 feet.
Moderately fractured	Lengths mostly in 4" to 1 foot range with most lengths about 8"
Intensely fractured	Lengths average from 1 to 4" with scattered fragmented intervals with lengths less than 4"
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration; not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT ENGINEER: SIGN OFF DATE:

PREPARED BY: A. Sanchez

CHECKED BY: E. Johnson

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

BRIDGE NO.

POST MILE 19.47

ROCK LEGEND

LOG OF TEST BORINGS 5 of 7

GS-LOTB ROCK LEGEND

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA 478301

DESIGNED PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET OF

PLOT TIME = 08:00:00 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
01	Hum	169	19.47		

REGISTERED GEOLOGIST — DATE 8-25-08

PLANS APPROVAL DATE

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REGISTERED GEOLOGIST — WILLIAM V. MCCONNICK III — No. 1975 — Exp. 11-30-08 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

K.LEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

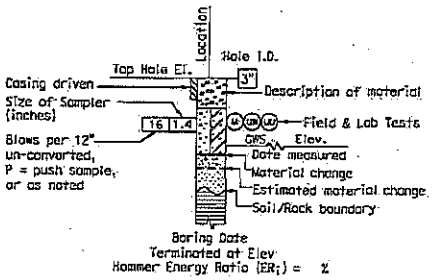
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
☐	O	Other

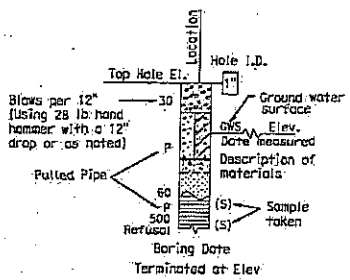
Note: Size in inches.

PLASTICITY OF FINE-GRAINED SOILS

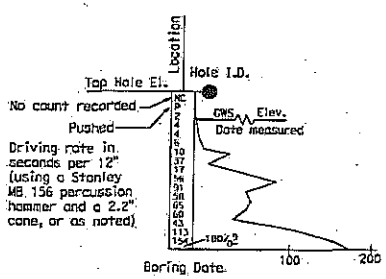
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



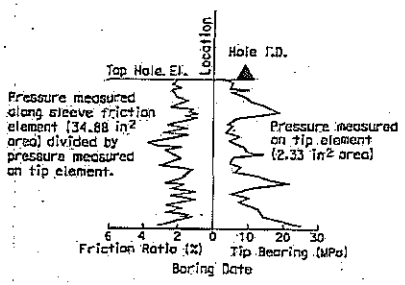
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT ENGINEER:	SIGN OFF DATE:
PREPARED BY	A. Sanchez
CHECKED BY	E. Johnson

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

DISTRICT NO. 01 — POST MILE 19.47

SOIL LEGEND

LOG OF TEST BORINGS 6 OF 7

CU
EA 476301

DISREGARD PRINTS BEARING EARLIER REVISION DATES

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

TITLE AS REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
01	Hum	169	19.47		

REGISTERED GEOLOGIST — DATE 8-25-08

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED GEOLOGIST WILLIAM V. McGOWAN III No. 1673 Exp. 11-30-08 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

KLEINFELDER
2240 NORTHPOINT PKWY.
SANTA ROSA, CA 95407

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT ENGINEER: SIGN OFF DATE:

PREPARED BY: A. Sanchez

CHECKED BY: E. Johnson

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA 478301
(FILE #3 BREQUEST)

ORIGINAL NO. | POST MILE 19.47

SOIL LEGEND

LOG OF TEST BORINGS 7 of 7

DISREGARD PRINTS BEARING EARLIER REVISION DATES

SHEET OF SHEETS

DS LGTS SOIL LEGEND

KLEINFELDER
Bright People. Right Solutions.

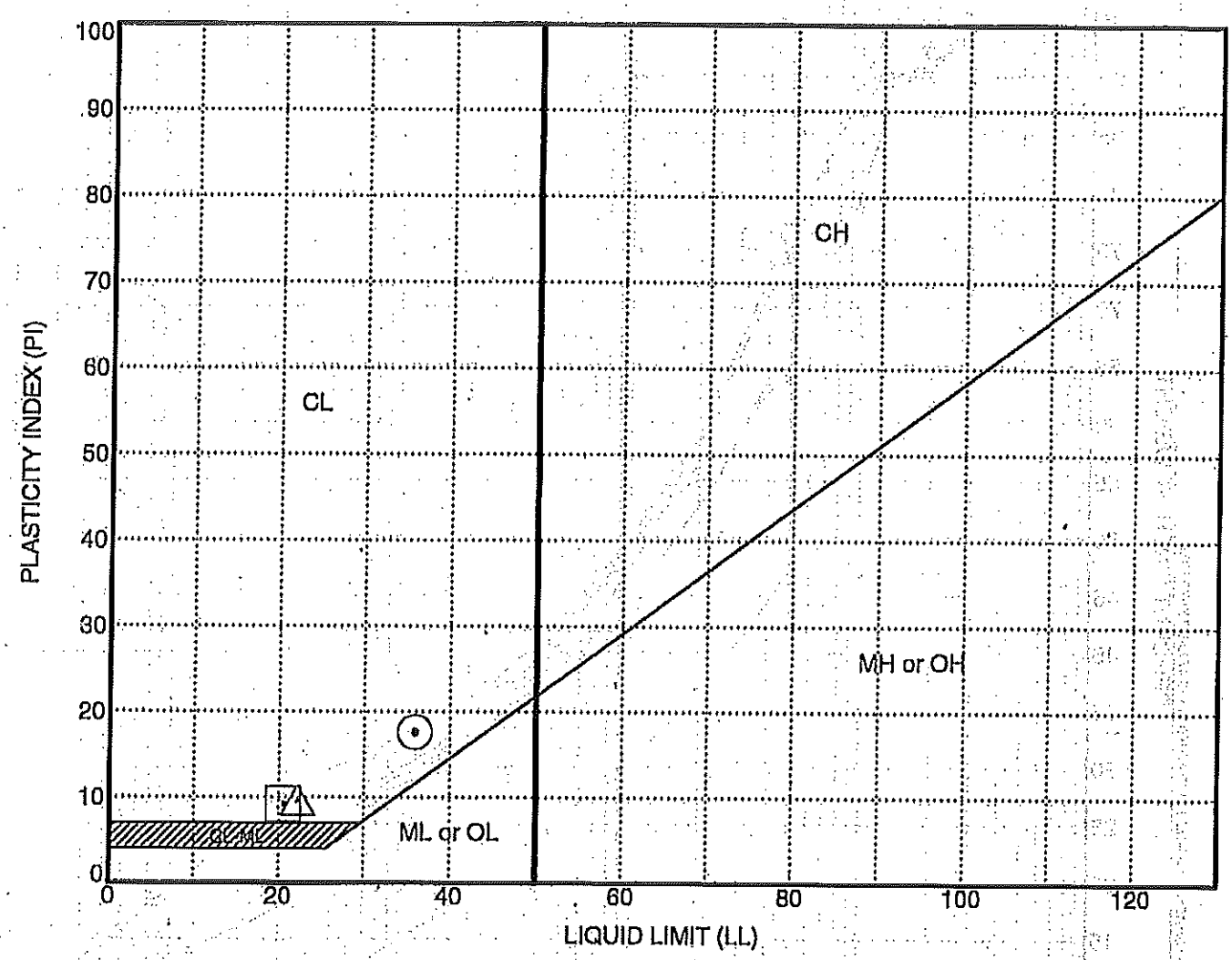
APPENDIX B

Highway 169 PM 19.47
Humboldt County, CA
EA # 01-478301

Laboratory Summary Sheet

Soil/Rock Type	Boring	Depth (ft)	TXUU (tsf)	TXUU (psf)	Confining Pressure (psf)	Dry density (pcf)	Moisture content (%)	Total density (pcf)	PI	LL	-200	Other
FILL (GC-GM)	R-08-001	6									31	
FILL (GC-GM)	R-08-001	11				137	7.2	147				
COLLUVIUM (GC-GM)	R-08-001	15.5	0.4	868	994	136	10.9	151				
FILL/ LANDSLIDE (SC-SM)	R-08-002	5.5									27	
COLLUVIUM (SC-SM)	R-08-002	11									26	
COLLUVIUM (SC-SM)	R-08-002	11										CR
COLLUVIUM (SC-SM)	R-08-002	15							18	36		
COLLUVIUM (SC-SM)	R-08-002	16				123	12.3	138			28	
COLLUVIUM (SC-SM)	R-08-002	21				121	12.7	136			28	
META-SANDSTONE	R-08-003	5.5									13	
META-SANDSTONE	R-08-003	6				131	7.7	141				
FILL/ LANDSLIDE (SC-SM)	R-08-004	6	0.2	425	504	131	10.1	144				
FILL/ LANDSLIDE (SC-SM)	R-08-004	6										CR
FILL/ LANDSLIDE (SC-SM)	R-08-004	7									20	
META-SANDSTONE W/ META-SHALE	R-08-004	16				133	7.5	143			10	
META-SANDSTONE W/ META-SHALE	R-08-004	20.5	0.3	654	1512	134	9.2	146				
META-SANDSTONE W/ META-SHALE	R-08-004	21	0.8	1592	2707	138	6	146				
META-SANDSTONE W/ META-SHALE	R-08-004	25							10	21	22	
ARGILLITE	R-08-004	37.5				137	8.2	148	9	22	34	
FILL/LANDSLIDE (SC-SM)	R-08-005	5.5									22	
COLLUVIUM/ LANDSLIDE (SC-SM)	R-08-005	16									41	
COLLUVIUM/ LANDSLIDE (SC-SM)	R-08-005	16.5	1.1	2295	994	125	12.9	141				

TXUU Triaxial Unconsolidated Undrained Strength
PI Plasticity Index
LL Liquid Limit
-200 Percent Passing 200 Sieve
CR Corrosivity
tsf tons per square foot
psf Pounds per square foot



SAMPLE SOURCE	CLASSIFICATION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	% PASSING #200 SIEVE
⊙ R-08-002 @ 15.0	SILTY, CLAYEY SAND with GRAVEL (SC-SM)	36	18	18	
⊡ R-08-004 @ 25.0	META-SANDSTONE with META-SHALE INTERBEDS	21	11	10	22
△ R-08-004 @ 37.5	ARGILLITE	22	13	9	34

KLEINFELDER
Bright People. Right Solutions.

PROJECT NUMBER EA # 01-478301 DATE 8/22/2008

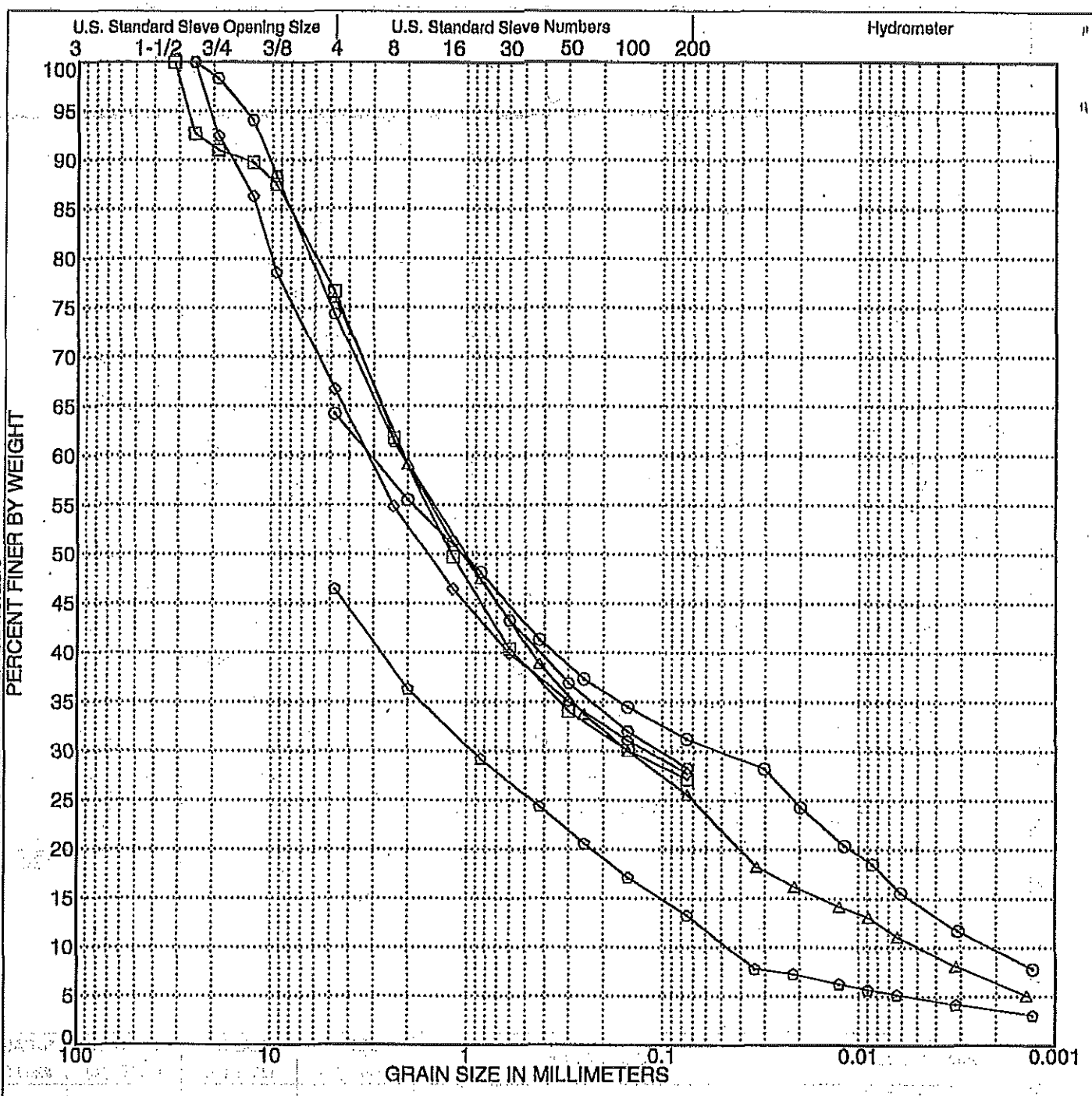
PLASTICITY CHART

Highway 169 PM 19.47
01-HUM-169-19.47
Humboldt County, CA

PLATE

B-1

Data Template:
PI - KLEINFELDER SANTA ROSA 5-8-08 .GDT - 8/22/08 13:49 - L:\NEW GINT PROJECTS\92858 CALTRANS TO# 5891601-HUM-169 PM 19.47\169 PM 19.47 LAB TESTS.GPJ



Cobbles	GRAVEL		SAND			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	SAMPLE SOURCE	CLASSIFICATION
⊙	R-08-001 @ 6.0'	SILTY, CLAYEY GRAVEL with SAND (GC-GM)
⊡	R-08-002 @ 5.5'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
△	R-08-002 @ 11.0'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
◇	R-08-002 @ 16.0'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
⬡	R-08-002 @ 21.0'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
⬠	R-08-003 @ 5.5'	META-SANDSTONE

KLEINFELDER
Bright People. Right Solutions.

PROJECT NUMBER EA # 01-478301 DATE 8/22/2008

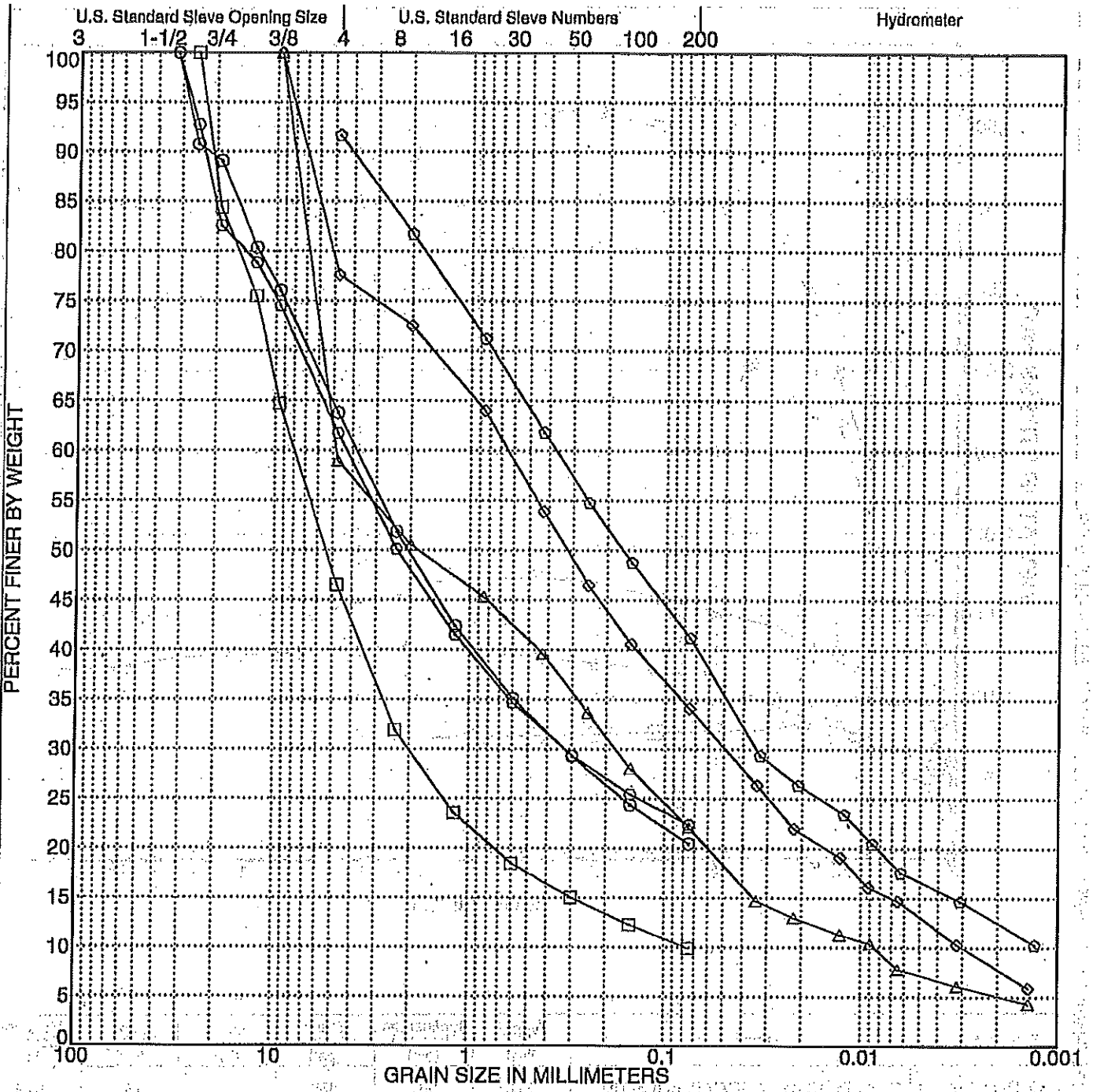
PARTICLE SIZE ANALYSIS

Highway 169 PM 19.47
01-HUM-169-19.47
Humboldt County, CA

PLATE

B-2

Data Template:
SA - KLEINFELDER SANTA ROSA 5-8-08 .GDT - 8/22/08 13:50 - U:\NEW GINT PROJECTS\92859 CALTRANS TO# 58916\01-HUM-169 PM 19.47\169 PM 19.47 LAB TESTS.GPJ



Cobbles	GRAVEL		SAND			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	SAMPLE SOURCE	CLASSIFICATION
⊙	R-08-004 @ 7.0'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
⊡	R-08-004 @ 16.0'	META-SANDSTONE with META-SHALE INTERBEDS
△	R-08-004 @ 25.0'	META-SANDSTONE with META-SHALE INTERBEDS
◇	R-08-004 @ 37.5'	ARGILLITE
⬡	R-08-005 @ 5.5'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
⬠	R-08-005 @ 16.0'	SILTY, CLAYEY SAND (SC-SM)

KLEINFELDER
Bright People. Right Solutions.

PROJECT NUMBER EA # 01-478301 DATE 8/22/2008

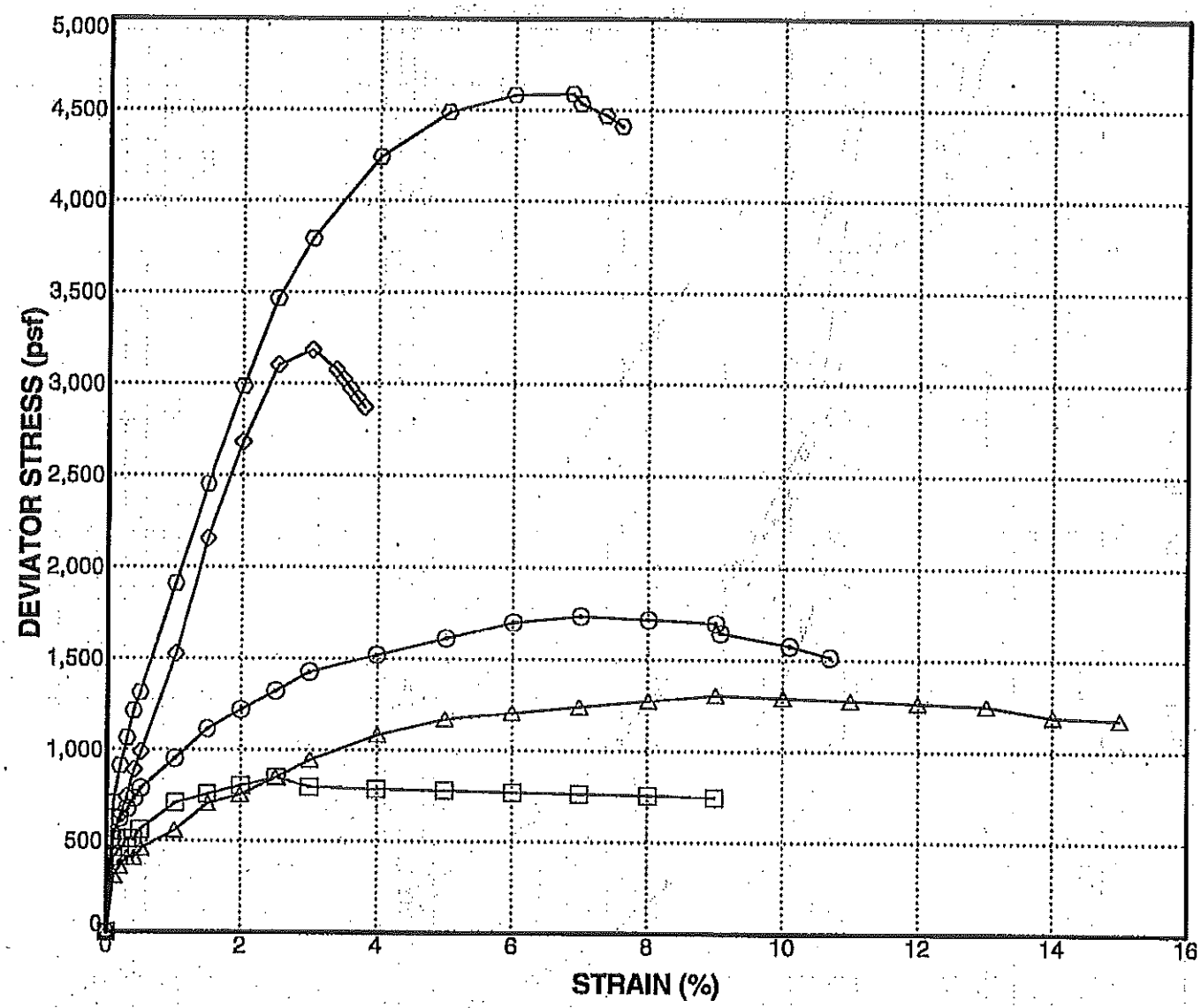
PARTICLE SIZE ANALYSIS

Highway 169 PM 19.47
01-HUM-169-19.47
Humboldt County, CA

PLATE

B-3

Data Template:
SA - KLEINFELDER SANTA ROSA 5-8-08 .GDT - 8/22/08 13:50 - U:\NEW GINT PROJECTS\92859 CALTRANS TO# 58916\01-HUM-169 PM 19.47\169 PM 19.47 LAB TESTS.GPJ



Sample Source	Classification	Type of Test	Confinement Pressure (psf)	Shear Strength (psf)	Strain (%)	Dry Density (pcf)	Moisture Content (%)
⊙ R-08-001 @ 15.5'	SILTY, CLAYEY GRAVEL with SAND (GC-GM)	TXUU	994	869	7	136	10.9
⊡ R-08-004 @ 6.0'	CLAYEY GRAVEL (GC)	TXUU	504	425	3	131	10.1
△ R-08-004 @ 20.5'	META-SANDSTONE with META-SHALE INTERBEDS	TXUU	1512	654	9	134	9.2
◇ R-08-004 @ 21.0'	META-SANDSTONE with META-SHALE INTERBEDS	TXUU	2707	1592	3	138	6.0
⊙ R-08-005 @ 16.5'	SILTY, CLAYEY SAND (SC-SM)	TXUU	994	2295	7	125	12.9

UC = Unconfined Compression

TX/UU = Unconsolidated Undrained Triaxial

KLEINFELDER
Bright People. Right Solutions.

PROJECT NUMBER EA # 01-478301 DATE 8/22/2008

STRENGTH TEST DATA

Highway 169 PM 19.47
01-HUM-169-19.47
Humboldt County, CA

PLATE

B-4

Data Template: NEW TXUU - KLEINFELDER SANTA ROSA 5-9-08 .GDT - 8/22/08 13:50 - U:\NEW GINT PROJECTS\92859 CALTRANS TO# 5891501-HUM-169 PM 19.47\169 PM 19.47 LAB TESTS.GPJ

AP Engineering & Testing, Inc.

CORROSION TEST RESULTS

Client Name: Kleinfelder
Project Name: Highway 169 PM 19.47
Project No.: EA#01-478301 (92859-Lab3)

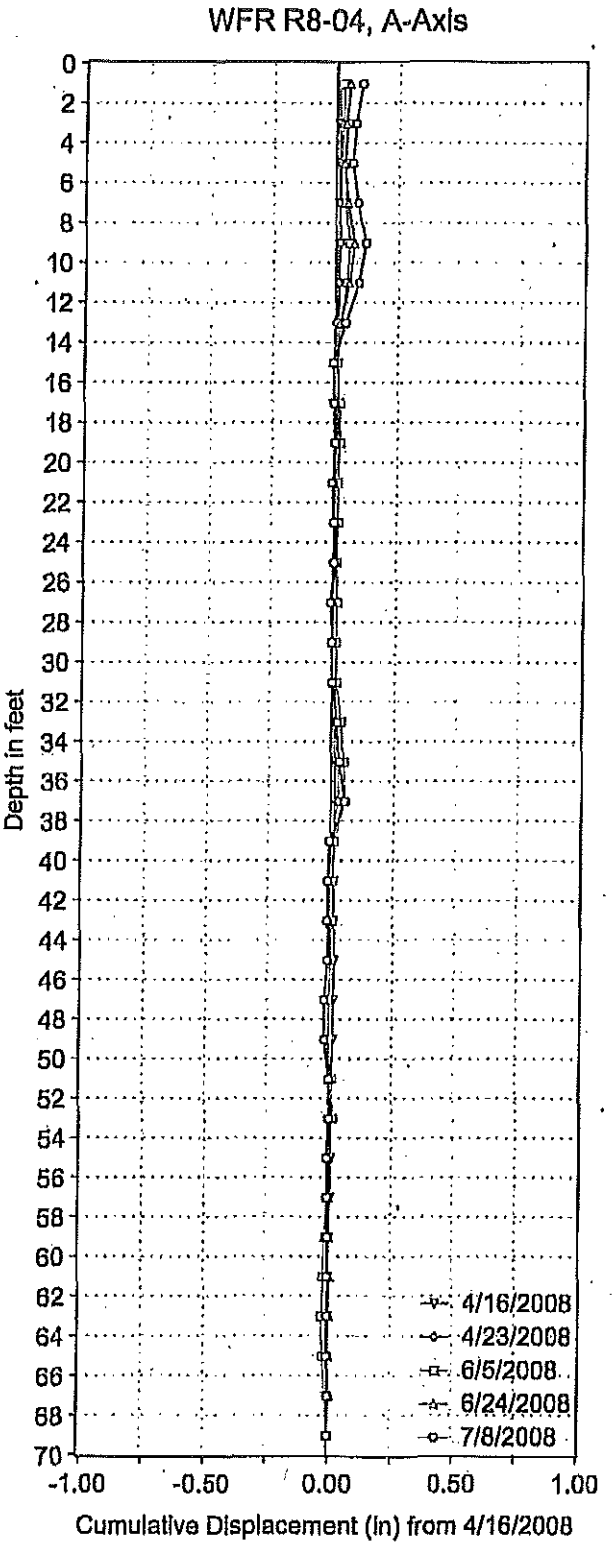
AP Job No.: 28-0500
Date: 05/01/08

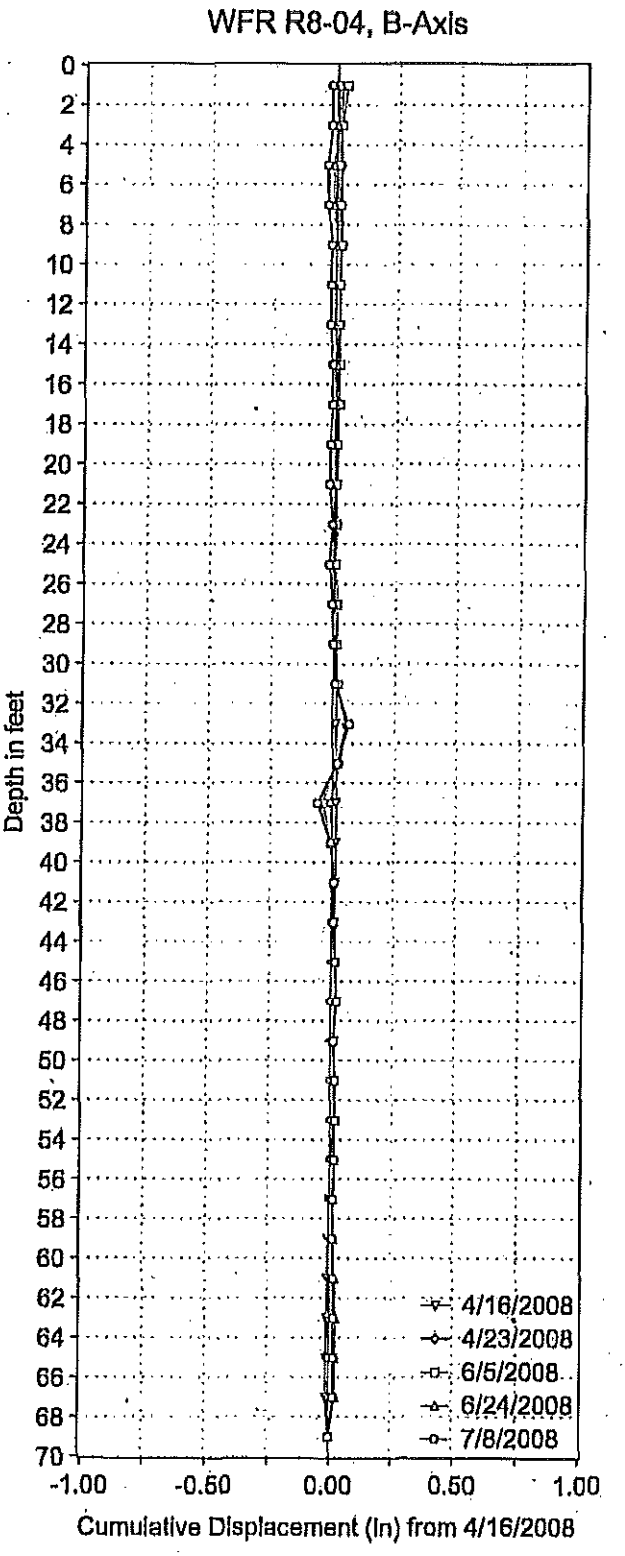
Sample ID.	Boring No.	Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
R-08-004	Core-6	6	ML	3600	7.5	7	126
R-08-002	Core-11	11	ML	3200	6.8	172	136

NOTES:
Resistivity Test and pH: California Test Methods 532 and 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

KLEINFELDER
Bright People. Right Solutions.

APPENDIX C





INCLINOMETER MONITORING RESULTS

01-HUM-169-PM 19.47
WALL FAILURE REPAIR
E.A. No.: 01-478301

Depth of Inclinometer Casing: 69 feet
Ao Direction: N/A° (Magnetic North)
Location (WGS-84) : N/A

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!

Be energy efficient.

To: Gudmund Setberg
Structure Design Branch 3
Office of Bridge Design – North

Date: January 30, 2009

File: 01-HUM-169-PM 19.47
EA: 01-478301
Bridge No. 04E0023

Attn: Erika Ward

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Report Addendum, NotchkoWall

This addendum was prepared to provide revised recommendations for the above referenced structure. The recommendations contained herein supercede the recommendations contained in the original Foundation Report prepared by Kleinfelder, Inc., titled "Foundation Report (Wall/Roadway Failure)" dated September 11, 2008.

This addendum was necessary because of changes to the wall layout line and the length of wall. Office of Geotechnical Design North personnel modified the wall layout line and wall length following additional field investigations. (Figures 1 and 2) This layout conforms to the General Plan dated 1-09-2009.

These revisions account for the changed subsurface conditions resulting from the revised wall layout line. The new wall length was revised from 350 feet to 291.64 feet.

UNION LABEL

Foundation Recommendations

The soil parameters, coefficients, lagging depth, etc. are summarized in the table below. The recommended design ground water should be at the bottom of the lagging, assuming the wall is completely drained to this depth.

Table 1: Soil & Rock Parameters for Retaining Wall Design

Type	Approximate Depth to Bottom of Layer, at Retaining Wall Location (ft)	Total Unit Weight (pcf)	Buoyant Unit Weight (pcf)	Angle of Internal Friction ϕ (degrees)	Cohesion c (psf)	K_a	K_p
Fill (Qaf)	11 to 15	146	84	37	0	0.25	See Table 2
Colluvium (Qc)	16-24	142	80	38	0	0.24	See Table 2
Fractured Bedrock (KJfss)	26	150	88	48	0	0.15	2.8

Table 2: Wall Design Parameters

Wall Height (ft)	Number of Tiebacks	Load (kips)*	Depth to Bedrock (from top of wall) (ft)	K_p (soil below lagging)	Pile embedment (ft)*	Recommended Pile length (ft)
26	2	85 and 58	26	N/A Excavate to bedrock	8.5	35
22	1	100	26	0.5	9.2	35
18	1	82	26	0.5	10.2	35
14	1	54	26	0.5	13.0	35
10	1	43	26	0.5	16.3	35
8	--	--	26	1.2	22.0	35

Notes: * from CT Flex analysis check

Tieback Anchors

Tieback anchors should derive their support solely from the bedrock formation (KJfss). An unbonded length of 35 feet is recommended for the upper row and 25 feet for the lower row of tieback anchors.

If you have any questions or require further assistance, please call me at (707) 445-6036 or Jim Morris at (530) 265-0986.

REGISTERED GEOLOGIST
CHARLES FREDERICK NARWOLD
No. 2335
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
JAMES E. MORRIS
No. CE036925
Exp. 6-30-10
CIVIL ENGINEER
STATE OF CALIFORNIA

CHARLIE NARWOLD, C.E.G. #2335
Senior Engineering Geologist
Geotechnical Design – North
Branch B

JAMES E. MORRIS, PE
Senior Materials and Research Engr (SPC)
Geotechnical Design - North

Attachments:
c: OGDN Project File

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
01	Hum	169			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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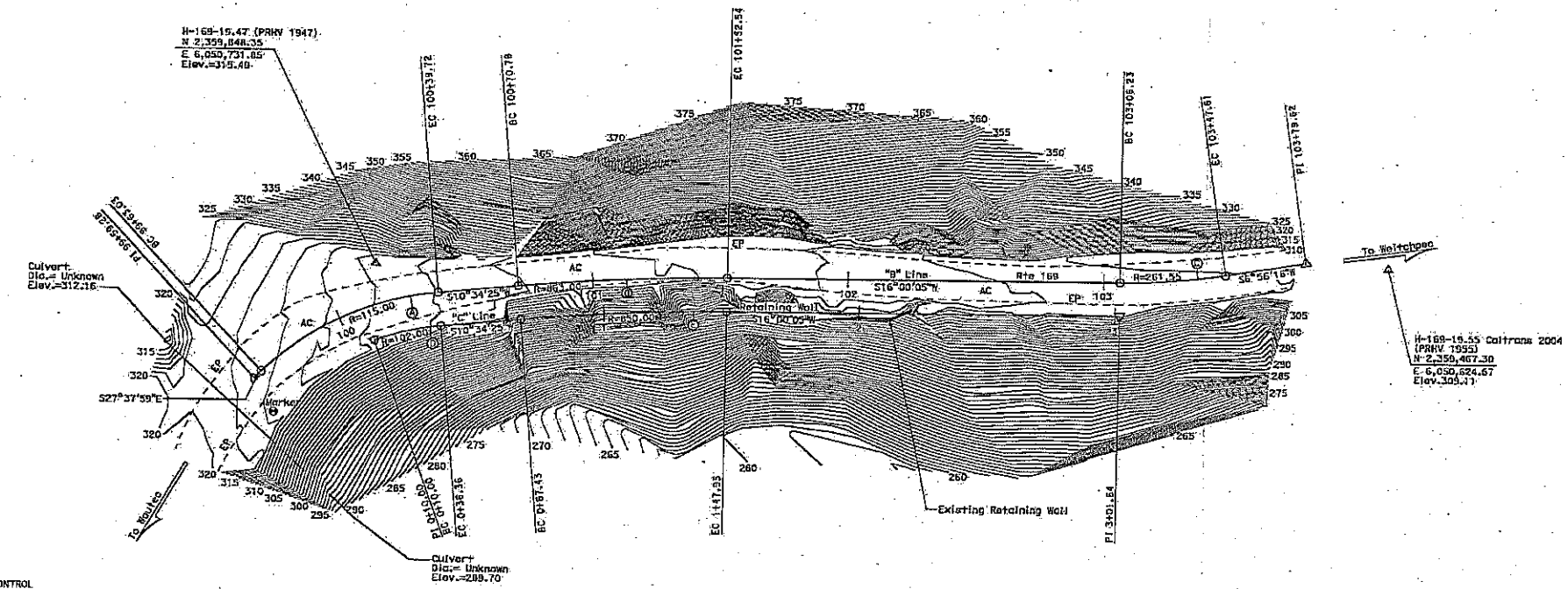
To get to the Caltrans web site, go to: http://www.dot.ca.gov

CURVE DATA

No.	R	Δ	T	L
(A)	115.00	38°12'24"	39.83	76.69
(B)	863.00	5°25'40"	40.91	81.75
(C)	261.55	9°03'49"	20.73	41.37
(D)	102.00	14°48'23"	13.25	26.36
(E)	850.00	5°25'40"	40.29	80.52



SURVEY CONTROL

H-169-19.47 (PRHV 1947)
Fnd Alcor
15.24 FT Lt. ℄ Rte 169
Sta. 00+19.64
N 2,359,848.35
E 6,050,731.05
Elev. = 315.49

H-169-19.55 Caltrans 2004 (PRHV 1955)
Fnd Alcor
78.57 FT S12°41'19"W From
Sta. 03+33.33 Rte 169
N 2,359,467.30
E 6,050,624.67
Elev. = 309.11

FIGURE 1

PRELIMINARY INVESTIGATION SECTION

SCALE 1"=20'	VERT.DATUM NAVD88		PHOTOGRAMMETRY AS OF: X		
HORZ.DATUM NAD83 (1991.35)	SURVEYED	BY Dietrict	CHECKED	BY T.Mason 08/2006	
ALIGNMENT TIES Stat.Traverse Sheet	DRAFTED	BY Y.Zoinikova 08/2006	CHECKED	BY L.Law 08/2006	

DESIGN	BY E. Emerick	CHECKED
DETAILS	BY E. Figueroa	CHECKED
QUANTITIES	BY	CHECKED

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 2

BRIDGE NO. 0E0023
POST MILE 19.47

CU 01
EA 478301

FILE => c1001.dgn

ORIGINAL SCALE IN INCHES FOR INDICATED PLANE 0 1 2 3

NOTCHKO RETAINING WALL
WALL LAYOUT LINE

REGISTERED PROFESSIONAL ENGINEER STATE OF CALIFORNIA

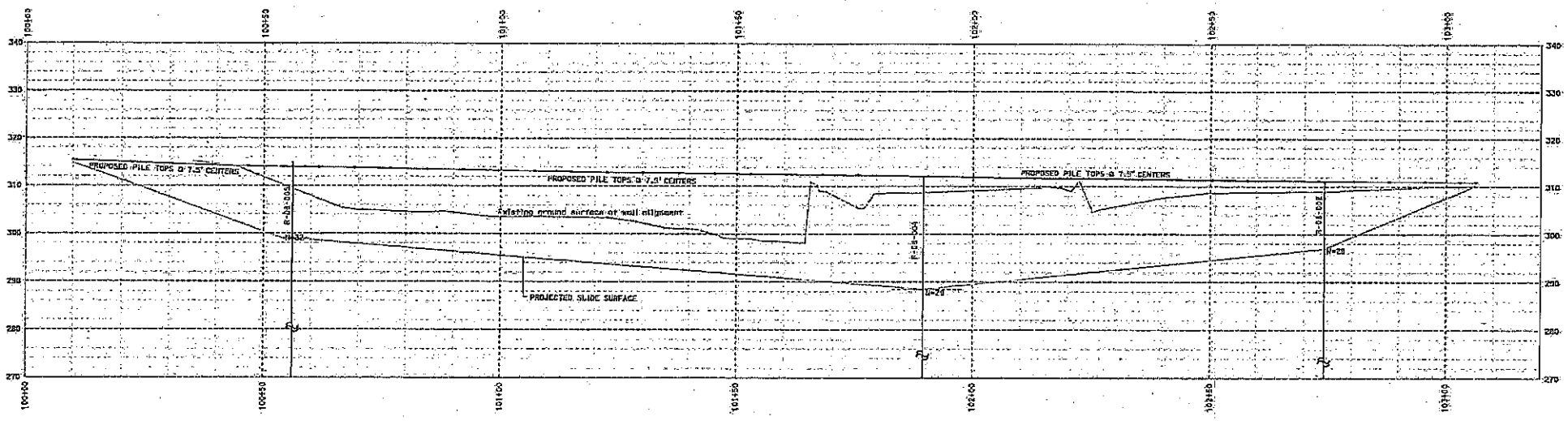
DIVISION DATES

SHEET 4 OF

STRUCTURES FOUNDATION PLAN SHEET (ENGLISH) DGN. 19/29/05

DATE PLOTTED => 19-JAN-2006 TIME PLOTTED => 13:33

USERNAME => T1100



NOTES:

THE SLIDE PLANE AND N VALUES WERE PROJECTED AT A 45 DEGREE ANGLE TO THE CURRENT WALL ALIGNMENT.

FIGURE 2

APPROXIMATE SUBSURFACE GEOLOGY ALONG WALL

HUM 169 PM 19.47 EA: 01-478301

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: Structure Design
1. Preliminary Report
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services
1. GS (Sacramento)
2. GS

District Project Development
District Project Engineer

Date: 4/2/09

Notchko Ret Wall
Structure Name

01 – Hum – 169 – 19.47
District – County – Route – Post Km M

01-478301 04E0023
E.A. Number – Structure Number

Foundation Report By: Klaus Felder + C. Narwold
Dated: 9/11/08 / 1/30/09

Reviewed By: E. Ward (OSD) R. Price (GS)

General Plan Dated: 3/19/09
Foundation Plan Dated: 3/19/09

[X] No changes. [ ] The following changes are necessary.

FOUNDATION CHECKLIST

- ✓ Pile Types and Design Loads
- ✓ Pile Lengths
- ✓ Predrilling
- ✓ Pile Load Test
- Substitution of H Piles For Concrete Piles [ ] Yes [ ] No
- ✓ Footing Elevations, Design Loads, and Locations
- ✓ Seismic Data
- ✓ Location of Adjacent Structures and Utilities
- ✓ Stability of Cuts or Fills
- ✓ Fill Time Delay
- ✓ Effect of Fills on Abutments and Bents
- ✓ LOTB's
- ✓ Fill Surcharge
- ✓ Approach Paving Slabs
- ✓ Scour
- ✓ Ground Water
- ✓ Tremie Seals/Type D Excavation

Office of Structure Design — Branch No. 2 — Geotechnical Services

Rev. 10/02

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C058-023-10T

DEPARTMENT OF TRANSPORTATION
(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 1656 Union Street, Eureka, California 95833
(MAILING ADDRESS)

at ROUTE 169 IMPROVEMENTS – NOTCHKO WALL REPAIR
(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***
(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The thirty-nine 30-inch diameter by 37 feet deep drilled shaft solider pile wall project located along Route 169 (Martin's Ferry Road), approximately 14.3 miles northwest of the intersection of Route 169 and Route 96, Weitchpec, Humboldt County.

This classification shall be conspicuously posted at the place of employment.

Date December 1, 2009

(SENIOR ENGINEER)

John R. Leahy

03 77069